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Statistical
Reporting
Service

Miscellaneous
Publication
Number 1308

Scope and Methods of the Statistical Reporting Service

Abstract

USDA's Statistical Reporting Service, through a network of State Statistical Offices, surveys farms, ranches, and businesses to make estimates on every aspect of U.S. agriculture. This volume describes methods and procedures, including survey design, data collection, and report preparation. It details estimation programs for field crops, vegetables, fruit, nuts, livestock, poultry, other crops, agricultural prices, and farm wages. Extensive research underway to improve methods includes assessing crops by satellite, simulating plant growth by computer, expanding use of objective surveys, streamlining data collection and processing, and reducing nonsampling errors.

Keywords: Enumerative survey, estimate, field crops, livestock, objective yield, prices, remote sensing, sample survey, sampling frame, stocks, wages

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Scope and Methods of the Statistical Reporting Service

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Foreword

Although the primary mission of the Statistical Reporting Service (SRS) continues to be collecting and publishing agricultural statistics, procedures and methods have changed significantly since 1975, when *Scope and Methods* was last issued.

Demands for more reliable estimates, the evolving organization of U.S. agriculture, and advances in estimating techniques have prompted these changes. Prices of farm commodities, which are increasingly sold on a volatile world market, are sharply more sensitive to the reliability of crop and livestock estimates. At the same time, the modern farmer has become an executive who demands and makes effective use of timely information. Processors and handlers rely on agricultural statistics to make crucial decisions as markets become more competitive and costs inflate. Legislators and farm program administrators increasingly depend on reliable data when taking actions with far-reaching impacts.

SRS has maintained its basic structure: headquarters staff in Washington, D.C., and 44 State Statistical Offices which serve the 50 States. Most State offices are joint Federal-State endeavors. However, the estimating procedures used, the overall reporting program, and the methods used to disseminate information have undergone substantial modification since 1975. Because of a shrinking budget measured in real dollars, some reports have had to be eliminated, reduced in geographic scope, or curtailed in frequency. SRS has placed great emphasis on guidance obtained from the users of agricultural statistics when making changes in the estimating program. The growing importance of reliable estimates has added impetus to the use of probability sampling methods. Technological advances including some operational use of satellite observations have been incorporated into the estimating process. Electronic dissemination of reports over computer networks has emerged as a new vehicle for providing timely statistics to the public.

This publication is the fourth of its kind since 1949 issued to inform the public about the work of SRS. The present volume will provide users and students of the agricultural data system in the United States with an extensive description of the organization and procedures currently used by SRS in making estimates. It is the product of many individual staff members who are the source of the basic strength of SRS.

W. E. KIBLER
Administrator
Statistical Reporting Service

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Preparation of this volume was an agencywide undertaking, the combined efforts of more than 50 authors and typists in the Washington, D.C. office. The staff of the EMS Information Division assisted with editing, design, art preparation, and publication. Special thanks are due to Melody Shaffer for coordinating preparation of the manuscript.

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Abbreviations

The abbreviations listed below appear in the text. The reader should refer to the Glossary following Chapter 12 for definitions of specialized terms.

ADP	Automated data processing
AgRISTARS	Agricultural and resource inventory surveys through aerospace remote sensing
A&P	Acreage and production survey
AMS	Agricultural Marketing Service, U.S. Department of Agriculture
ARS	Agricultural Research Service, U.S. Department of Agriculture
ASCS	Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture
CATI	Computer-assisted telephone interviewing
C/C	Current/current survey indication
CCC	Commodity Credit Corporation, U.S. Department of Agriculture
C/H	Current/historical survey indication
CPI	Consumer price index
CRB	Crop Reporting Board
CSA	Cross-sectional area
CV	Coefficient of sampling variation
DCLC	Domestic crops and land cover project
DES	December enumerative survey
FAS	Foreign Agricultural Service, U.S. Department of Agriculture
FPES	Farm production expenditures survey
FSIS	Food Safety and Inspection Service, U.S. Department of Agriculture
JES	June enumerative survey
MSS	Multispectral scanner
NASA	National Aeronautics and Space Administration
NASDA	National Association of State Departments of Agriculture
NOAA	National Oceanographic and Atmospheric Administration, U.S. Department of Commerce
PDE	Portable data entry device
PPM	Plant process model
PSU	Primary sampling unit
RE	Relative efficiency
RMSE	Root mean square error
SIC	Statistician in charge
SRS	Statistical Reporting Service, U.S. Department of Agriculture
SSO	State statistical office
TM	Thematic mapper
USDA	U.S. Department of Agriculture

Chapter 1

An Overview of the Statistical Reporting Service

Introduction

The structure of farming and the agricultural industry have changed dramatically over the more than 100-year history of the Statistical Reporting Service (SRS). The purpose of the organization, however, has remained the same: collecting and disseminating current statistics on the Nation's agriculture.

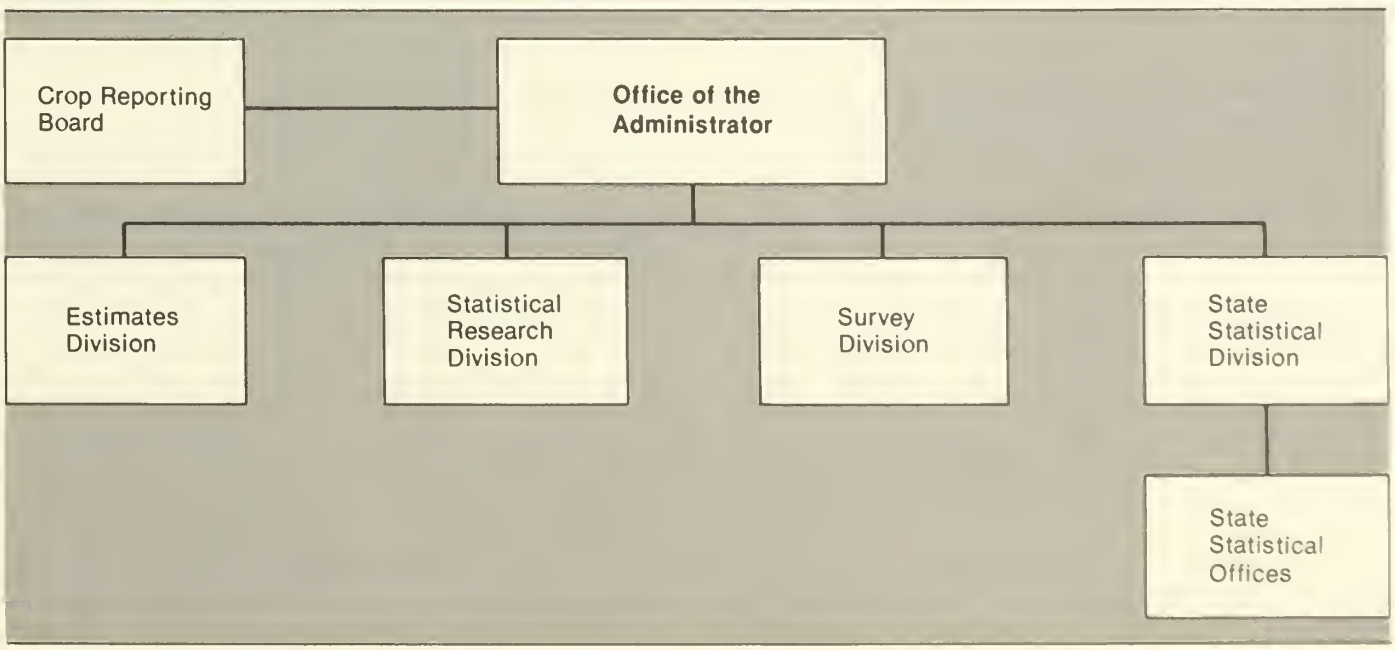
U.S. farmers, ranchers, and others in agriculture require reliable information on production, supplies, marketings, prices, weather, and a vast array of other inputs. To meet this need, SRS maintains a network of 44 field offices, serving the 50 States, through cooperative agreements with State departments of agriculture or universities. (Field office locations are shown on the map inside the back cover.) These State Statistical Offices (SSO's) regularly survey thousands of operators of farms, ranches, and agribusinesses who voluntarily provide information on a confidential basis. Statisticians consolidate these reports with field observations, objective yield measurements, and other data to produce State estimates. These estimates are forwarded to SRS headquarters in Washington, D.C., where they are combined and released at the national level.

To ensure accurate estimates, SRS relies on a combination of long experience in conducting surveys and constant improvements in techniques. Chapter 2 of this volume provides the reader with an introduction to the statistical concepts that sample surveys employ and the techniques used to translate facts gleaned from surveys into crop and livestock estimates. Chapter 3, devoted to data collection, describes in practical terms how SRS personnel conduct surveys and process information into published reports. These general chapters provide necessary background for understanding the estimating programs for specific commodities that are described in later chapters.

SRS issues about 300 national and 9,000 State reports each year. Every report is released on a fixed schedule according to an annual calendar of release dates. Strict security measures are followed to ensure that no one gains premature access to estimates.

SRS reports provide broad coverage of agriculture, including about 120 crops and 45 livestock items. The annual cycle of crop reports begins with estimates of the

Figure 1. **Organization of the Statistical Reporting Service**



acreages that farmers intend to plant, and continues with estimates of planted acreages, acreages intended for harvest, probable yields, and potential production. Estimates of acreages harvested, actual yields, and production are made at the end of the season. Utilization, disposition, and value of the commodities produced are subsequently issued. Chapters 4, 5, and 6 explain the estimation programs for field crops, vegetables, and fruit and nuts.

Livestock inventory numbers are published annually or semiannually. Seasonal details on hog production, cattle on feed, and production of eggs, milk, and meat are issued during the year in monthly and quarterly reports. Reports on breeding intentions, farrowings, hatchings, chick placements, and calf and lamb crops provide indications of prospective market supplies. Estimates of manufactured dairy products and cold storage holdings of agricultural commodities are also published regularly. Livestock, dairy, and poultry estimates are the subjects of Chapters 7, 8, and 9.

The economic importance of the farm commodities covered by SRS reports has grown dramatically in the past decade. Illustrations in Chapters 4 through 9 chart this growth for major commodities and identify the leading States for their production.

SRS statistics apply to a variety of additional subjects vital to agriculture. These include fertilizer, number and size of farms, farm labor and wages, prices received and paid by farmers and associated indexes, grain stocks, mushrooms, mink, catfish processed, and weekly weather and crop bulletins. Chapter 11 describes the reporting programs for these subjects.

Collecting and issuing agricultural statistics is the primary, but not the only, activity of SRS. Research is constantly underway to improve the statistical methods and enhance the accuracy of agricultural estimates. This research is directed toward better sampling, yield forecasting, and survey techniques. A significant volume of research has been generated in recent years to improve accuracy of domestic and foreign crop acreage and land cover estimates, to develop an early warning satellite detection of unusual events and crop conditions, and to improve crop yield estimating. The final chapter explores these research activities in detail, providing an intriguing glimpse into future means of gathering information about agriculture.

SRS also conducts surveys on a reimbursable basis for other Federal, State, and private agencies or associations. This service enables organizations which lack the means to conduct extensive surveys in rural areas to take advantage of the nationwide SRS network of trained staff and field offices.

Technical support of agricultural statistics programs in developing countries has also become an integral part of the SRS program. Working through various international organizations that coordinate foreign programs, SRS supplies technical experts in sampling frame development, survey design, data collection, summarization, and analysis. SRS generally provides the support through short-term, temporary duty assignments of its personnel.

Usefulness of Statistics

Crop and livestock statistics help develop a stable economic atmosphere and reduce risk for production, marketing, and distribution operations. Modern agriculture increasingly calls upon SRS to supply reliable, timely, and detailed information in its commodity estimating program.

Uses of statistical information are extensive and varied. A main user is the producer, although the unique impact of crop and livestock data on a given producer depends on the type and size of operation. To cash-crop farmers, who have more alternatives in planning crop acreage than those producing feed crops for use on the farm, early-season indications of acreage planted nationally and regionally are quite useful. Information on production and stocks helps producers of crops that can be stored to find their best market opportunity; producers of perishable crops are interested in the timing of plantings and the acreages planted as an indication of market flow during the harvest period.

Livestock producers and feeders, including poultry producers, evaluate a wide range of information when making decisions on purchases, sales, and capital investments. They use data on inventory numbers, together with reports of breeding intentions, slaughter, prices, and crop production.

Other important users of agricultural statistics are farm organizations, agribusinesses, State and national farm policymakers, and foreign buyers of agricultural products. Uses of data by farm groups may range from maintaining a basic data series to preparing an important marketing campaign. Farm supply firms also rely heavily on statistics when planning purchases and sales of feed, fertilizer, machinery, fuel, seed, and other farm production items. For those engaged in marketing,

processing, and distributing agricultural products, supply and demand information is useful for linking producer and consumer.

Government agencies at various levels are important users of statistics. Federal farm programs require information on acreages, production potential, stocks, prices, and income. Agricultural statistics are used to plan and administer other related Federal and State programs in such areas as consumer protection, conservation, foreign trade, education, and recreation.

An important user of agricultural statistics in each of the categories already mentioned is the analyst. The analyst transforms statistics into projections of current trends, interpretations of their economic implications, and evaluations of alternative courses of action in terms of prospective outcomes. These projections multiply the usefulness of statistics.

The SRS Structure

SRS is a broad-based, nonpolicymaking organization headquartered in Washington, D.C., with SSO's serving all States. Responsibilities of the national office are shared by four divisions: Statistical Research, Survey, Estimates, and State Statistical. Figure 1 depicts the agency organization.

Main SRS responsibilities are collecting, preparing, and publishing regular series of crop and livestock estimates and data on related elements of farming. SRS also conducts statistical research to improve methods of gathering, evaluating, and processing information.

A program planning committee is responsible for reviewing the entire agency program and making recommendations to the SRS administrator concerning program and policy modifications. The deputy administrator chairs the committee, the assistant to the administrator (who serves as secretary) and division directors are permanent members, and four State statisticians-in-charge (SIC's), selected for regional representation, rotate membership.

Estimates Division

The Estimates Division is the primary source in SRS for the agricultural statistics, including their analysis and interpretation, that the Crop Reporting Board (CRB) uses in making estimates and forecasts. The division evaluates commodity statistics, determines needs, and implements statistical plans in support of the crop and livestock reporting program, and ensures that appropriate methods and procedures are used. Much of this publication concerns the day-to-day work of the Estimates Division.

Crop Reporting Board

The CRB reviews and adopts official State and national estimates for crops and livestock as required by USDA regulations (see Appendix C). The board includes a chairperson, the SRS deputy administrator; a vice chairperson, the director of the Estimates Division; and a secretary, the chief of the Data Services Branch in the Survey Division. In addition to these permanent members, five or six statisticians are selected from the agency staff to participate in board deliberations. Two or three of these additional members are from SSO's; the remaining personnel are selected primarily from the Estimates Division.

Survey Division

The Survey Division establishes procedures used by the SSO's in collecting data by mail and enumerative surveys, and for the objective yield measurement program. Division specialists design and test sample survey techniques, forms, and questionnaires; write data collection instructions; and conduct training schools for field staff. Much survey information is processed by the division through a teleprocessing network contract and USDA's computer capabilities. The summaries produced are used by SSO's and the CRB in setting official estimates. Specialists work to improve methods of survey operations, automatic data processing, transmission, storage, and retrieval systems, and related operations. The division also conducts data collection activities for other USDA and Federal and State agencies on a reimbursable basis.

State Statistical Division

The State Statistical Division is responsible for the overall administrative direction and coordination of the operations and program activities of all SSO's. This program is conducted in cooperation with State governments to collect data on national crop and livestock production and supply, prices, and other related aspects of the agricultural economy.

SSO's conduct surveys in all 50 States. The New England office, located in Concord, N.H., covers the

six New England States. The Maryland office, located in Annapolis, Md., also serves Delaware. The SSO's are the primary data collecting, processing, evaluating, estimating, and State publishing units of SRS. Each State conducts surveys in accord with technical instructions prepared and issued from the national SRS office. The division allocates funds and staff to each of the SSO's and assures that expenditures and staffing in each SSO are within the budget and State allocations.

Each SSO collects and summarizes data, prepares recommended estimates for its State or States, and submits them to the CRB. After reviewing these recommended estimates, the CRB then adopts State estimates which become part of the State and national data series, and releases a report to the public. The final section of this chapter describes this process in more detail.

The division provides liaison between SSO's and the Estimates, Survey, and Statistical Research Divisions. It also formulates current and long-range policies and programs to help accomplish the SRS mission. This includes the responsibility for planning and implementing policies and programs, providing managerial direction for program activities such as estimates and forecasts, and evaluating commodity statistics.

The division serves as the liaison between the National Association of State Departments of Agriculture (NASDA) and SRS. The two organizations have a formal cooperative agreement for NASDA to provide field enumerators for data collection. Other activities of the division include the coordination of training of personnel in SSO's and, with the help of the State SIC's, the recruiting and hiring of statisticians.

Statistical Research Division

The Statistical Research Division develops new and improved collecting, estimating, and forecasting methods for agricultural statistics and encourages the use of sound statistical techniques throughout USDA. The division devises improved sampling techniques and methods of controlling sampling errors, constructs and maintains area sampling frames, and researches nonsampling errors stemming from questionnaire wording, enumerators' interviews, or other causes. Activities include assessing new models for estimating and forecasting the yield of field and fruit crops and applying statistical analyses to improve existing models. The application of remote sensing technology in identifying crops, land use, and acreage measurements is another important area of research.

Federal-State Cooperation

SRS has cooperative agreements with 49 States through the State departments of agriculture, land-grant universities, and agricultural industries. The agreements provide financial support from State governments and agricultural industries to collect data for smaller geographical subdivisions, minor commodities, or other details not provided for by Federal appropriations. Cooperative Federal-State programs of collecting and disseminating agricultural statistics were started in 1917 and SRS has continually pursued a policy of working jointly with cooperators.

These programs enhance effectiveness of the total agricultural statistics program at the State level and, more importantly, prevent duplication of effort in acquiring data from farmers and in making State-level estimates of agricultural production. State resources are used to provide more complete detail on certain commodities, information for commodities of local importance, county estimates, and related activities not supported by Federal funds. The cooperation between SRS, State agencies, and agricultural industries generates more information with more efficient use of funds, lightens the burden on farmers and others who respond to questionnaires, and helps maintain consistency between the estimates derived by different public agencies.

Reimbursable Services

Conducting surveys, training, and other services on a reimbursable basis enables SRS to increase the productivity of its organization and to extend its unique knowledge of agricultural estimates.

Domestic

SRS conducts a wide variety of additional surveys and provides technical assistance for other USDA agencies and Federal and State Government units on a reimbursable basis. SRS support and assistance has been developed around a sample design and selection capability using both list and area sampling frames and the capability to control and direct survey design, training, and data collection activities used throughout the agency's field offices from a centralized location.

Reimbursable services consist of questionnaire design, sample design, data collection, data editing, and tabulation of survey results. SRS assistance provided to other agencies must meet these conditions:

- Services must not interfere with the proper performance of the SRS mission nor impair its ability to obtain information needed for regular programs.

- Services must serve the needs of those requesting aid and must provide useful data not available elsewhere. Data collected must be for the public good.

- SRS policy on the confidentiality of individual reports and on guidelines governing published data must be observed in all cases.

All such survey work is fully reimbursed, including overhead, during the fiscal year in which the services are performed.

Statistical Consulting

Many USDA agencies without statisticians consult with the Statistical Research Division on sample design and statistical analysis. This consulting may take from a few hours to months depending on the problems involved. Recent consulting for other USDA agencies ranged from a survey of the food service industry to a Mississippi survey of State parks. Statisticians also participate in the design of special, one-time surveys done by SRS. For example, the U.S. Department of Interior asked SRS to collect certain data on farmers in the irrigation districts of the Western United States. For this one-time survey, SRS constructed the frame, designed the sample, and directed the summarization.

International

SRS frequently provides technical assistance and training to foreign countries to help develop and improve their agricultural statistics programs. Training and technical assistance are given in:

- Sample design, including area-frame, list-frame, and multiple-frame construction for probability surveys;

- Data collection (questionnaire design, enumerator training, and field operations procedures);

- Data summarization, processing, analysis (on mainframe or microcomputers), and dissemination;

- Objective yield technology; and

- Remote sensing technology (as it relates to sample design and crop estimation procedures).

SRS specialists give the assistance on short-term assignments, with host country personnel maintaining responsibility for all aspects of their agricultural statistics programs. SRS technicians can also be provided for longer term resident assignments. All SRS technical assistance and training are on a reimbursable basis, with funding from the U.S. Agency for International Development, Food and Agriculture Organization of the United Nations, International Bank for Reconstruction and Development (World Bank), and, in some instances, host countries. All technical assistance requests for USDA support come through the Office of International Cooperation and Development.

Issuing Crop and Livestock Reports

An annual calendar is prepared in December showing the date and hour for releasing each CRB release during the coming year. The reports are released first in Washington, D.C.; SSO's then quickly make the national and State information available through local news releases and reports.

The survey and report preparation process begins in the SSO's. Data from surveys are edited, summarized, and analyzed. State statisticians prepare initial forecasts or estimates and transmit them, with appropriate supporting material, to the CRB for review. The law specifies statutory penalties that can be imposed upon SRS employees for disclosing any information prior to official release, or personally engaging in trading on the commodity markets: up to a $10,000 fine and 10 years in prison. Issuing false information may bring a $5,000 fine and 5 years in prison. Therefore, precautions are taken to prevent unauthorized access to any survey information or estimates before official release. Estimates of production of corn, wheat, cotton, soybeans, and sweet oranges, and the supply of grain in storage are considered "speculative." Since these commodities are heavily traded on commodity markets, anyone having early access to official estimates would have an obvious advantage in trading. Reports on the speculative commodities from the major producing States receive special handling. When they arrive at USDA in Washington, the materials are placed in a steel box secured by two locks. One key is held by the Office of the Secretary of Agriculture and the other by the CRB secretary.

Early on the morning a "speculative" report is to be released, the chairperson and a representative of the Secretary of Agriculture, escorted by a Federal Protective Service officer, open the box, remove the reports, and take them to the locked CRB quarters. Commodity statisticians in the Estimates Division and those serving on the CRB review commodity indications from the SSO's to arrive at the official national and State estimates.

While the reports are being prepared, the area is isolated and guarded. Doors are locked, window blinds are closed and sealed, and all telephones disconnected. For full lockups, food is sent in for the staff inside the lockup area. Only authorized persons may enter, and no one leaves until the report is released at 3:00 p.m., eastern time.

While many SRS reports are designated "nonspeculative"—livestock and poultry numbers, vegetables, potatoes, agricultural prices, cold storage holdings, and others—strict security precautions are still imposed. Although not prepared behind locked doors, material for these reports is worked on in restricted areas and access by unauthorized persons is denied.

Shortly before the lockup report is to be released, the Secretary of Agriculture or an assistant secretary enters the board room for a briefing on the contents of the report, which has been printed inside the lockup. The Secretary of Agriculture or the representative then signs the report. Two minutes prior to release time, the CRB chairperson and secretary take copies of the report to the newsroom outside the locked area. No communication with anyone is permitted. Reporters from wire services, newspapers, and other news media wait behind a restraining line for copies of the report. The reports are then made available to all at 3:00 p.m.

State and national estimates go immediately by computer network to the SSO's where information is provided to local news media and full reports are sent to data users who request them. Other distribution from Washington, D.C., to data users is accomplished through printed reports and electronic networks.

Chapter 2

Sampling and Estimation Methods

Introduction

Most of the information SRS publishes is based on data gathered through a system of sample surveys. SRS regularly surveys sample farms and agricultural businesses in order to make statistical inferences (estimates) for a total population.

The alternative to using a sample survey would be to make a complete enumeration, or count, of the entire population. Both cost and timely results favor the survey. SRS must gather information quickly to provide timely data for decisionmaking purposes. Many estimates are published only a few weeks after a survey begins. This kind of timeliness would be impossible to achieve if complete enumeration of a population was necessary. A well-designed sample survey is much more cost-efficient than a complete census, and may even be more accurate.

This chapter explains the concepts and sampling methods that SRS employs in developing surveys. The next chapter describes how the surveys are conducted and how the results are processed.

Every survey is constructed from a sampling frame. Early sections of this chapter explain the concept, construction, and maintenance of sampling frames. Later sections present the estimation procedures employed for different probability and nonprobability surveys.

Nonprobability surveys rely on responses to questionnaires sent to lists of crop reporters or other respondents. This traditional survey method still provides some of the data used by SRS. The more recent probability surveys usually employ enumerators who gather data from a small sample that is randomly selected from an entire population. The sections discussing probability surveys assume that the reader has some knowledge of sampling concepts.

Sampling Frames

Every sample survey requires the availability of a sampling frame. The population to be sampled, whether cattle, corn acres, or farms, must be divided into sam-

SRS uses aerial photos to divide all land within a State into small segments, classified according to land use. During a survey, enumerators visit selected segments, asking farmers to identify each crop planted by field.

pling units. The sampling frame defines the population and identifies the members that are available to be sampled. Sampling units can be names of people representing farm operations or units of land as delineated on photographs or maps. The basic requirements of an effective sampling frame are that its sample units, when aggregated, contain the entire population and that individual sample units do not overlap.

SRS surveys use two kinds of frames, the area frame and the list frame. The concept of area-frame sampling is simple. The land area to be surveyed is divided into small blocks, called segments, with unique and identifiable boundaries that can be delineated on aerial photographs or maps. The segments must cover the land area completely. No segment will have more than one chance of being selected. The sample is then a random selection of these small segments.

The area frame provides a sampling vehicle for an almost unlimited variety of surveys. The survey population can be composed of reporting units that are farm households, farm headquarters, animals, plants, suppliers of agricultural inputs, grain storage facilities, processors of agricultural products, or any other identifiable units that can be associated with segments of land. The primary advantage of area-frame sampling is that it provides a complete frame; that is, every segment of land, and thus all land, has a known chance to be selected, so all items being surveyed have a chance of being selected by their association with a unique segment. An area frame does not grow out of date in terms of coverage of the population, but it can become inefficient as the characteristics of the population change.

The area frame is most effective when used for general purpose agricultural surveys, because it is most efficient for estimating survey items that appear in a high proportion of the segments. Since it is nearly impossible to determine beforehand where large or specialty farms are located, it is difficult to adequately represent these operations in an area-frame sample. Extremely large samples are required to provide estimates for commodities that appear in less than one segment in five or are produced on less than one-fifth of the farms, or if the farms vary widely in size. Size variation is a particular problem with livestock or poultry operations.

A list of farm operators or agribusinesses can also constitute a sampling frame. This list sampling frame contains names and addresses along with control data that identify the relative size of the items being surveyed. The list frame has several advantages. It permits the use of data collection by mail and telephone. It also allows for use of more efficient sampling methods, especially for items grown on a small percentage of farms or where there is extreme variability in size of operation, as for livestock. If the list frame of farm operators contains information on relative size, the extremely large operations can be selected with high probability or certainty to minimize their impact on the sampling variability. A basic disadvantage of a list sampling frame is that it is nearly impossible to maintain a list that covers the entire population of interest or is completely up to date. In addition, maintaining a list frame with current names, addresses, and control data for sampling purposes is costly.

Multiple-frame sampling is a survey technique that uses list and area frames in combination to gain the advantages of both. The list frame is extremely efficient for large operations and operations that produce rare items. The area frame ensures complete coverage and can be used to estimate the incompleteness of the list frame.

Area Frames

The SRS area sampling frame consists of all the land area for a given State. Land use can vary considerably from intensively cultivated areas, to range land, to cities and towns. Since the area frame is a sampling vehicle for obtaining information about agricultural commodities, it is important to be able to select the sample so that agricultural areas are adequately represented. One method for accomplishing this is to classify land on the basis of its current use. Therefore, the first step in constructing an area sample frame is to delineate the different land uses in a State, by a process called stratification. Similar kinds of land use, especially as they relate to agricultural production, are grouped together into strata. Sampling rates for strata can be varied to select much larger samples from areas containing a lot of agriculture and smaller samples from those containing very little agriculture. The next stage is to divide land within each stratum into smaller units that can be randomly selected. The following section explains stratification and sample selection procedures in more detail.

Construction

Area-frame construction is a major undertaking which must be considered as a long-term investment. The efficiency of the frame over time depends on the strata definitions used and quality of the stratification job. SRS develops new area frames in three or four States per year as existing frames become obsolete.

Most States use six general land-use strata: intensive agriculture, extensive agriculture, cities and towns, range, nonagriculture, and water. The two agricultural strata are often further divided by percentage under cultivation (such as under 50 percent cultivated and 50 percent or more cultivated).

Stratification begins by dividing a State into manageable parts with clearly defined boundaries. Usually, counties are chosen for this purpose. Assuming that counties are being used, SRS personnel determine the major homogeneous areas of land use within each county and draw these strata onto large composite aerial photographs. Identifiable physical boundaries such as roads or rivers are used to clearly define boundaries between strata. Figure 2 illustrates how strata would be drawn for a hypothetical county.

Classifying land into strata requires accurate knowledge of current land use within a county. Aerial photographs, quadrangle maps, or satellite imagery are used for this purpose, supplemented by the general knowledge of land use and information gained from prior surveys, crop calendars, or county highway maps.

The next step is to subdivide each stratum in the county into several blocks called primary sampling units (PSU's). PSU's range in size from 0.2 to 10 square miles, depending on intensity of land use. PSU boundaries should be permanent physical landmarks such as roads or rivers that can be identified from the ground and that do not cross county boundaries.

The final step in stratification is to subdivide selected PSU's into segments of uniform size. Segments are the actual units that will be selected for sampling when surveys are conducted.

Determining Segment Size. The area-frame designers must assign the segment size to be used for each stratum in order to estimate the total number of segments statewide. Little quantitative information is available on optimum segment size. Past experience and analysis of the previous years' survey data are used to establish an optimum segment size based on variance and cost considerations. Segments in the agricultural strata are generally 1 square mile while those in the urban strata are as small as 0.1 square mile.

If the target segment size were 1 square mile, topographic characteristics would be examined when dividing a PSU into segments so that reasonable boundaries were available for land area of about 640 acres, give or take 10 percent. Available boundaries must be identifiable and must be given a high priority in determining segment size.

Each PSU is now measured with a grid of the assigned segment size to determine the number of segments it contains. This number is noted, and the number of segments in all PSU's for each strata statewide are tallied. However, no actual segment boundaries are mapped at this stage.

Sample Allocation. In the next step, called sample allocation, the frame designers decide how many segments in each stratum must be sampled to produce an estimate at the desired level of precision.

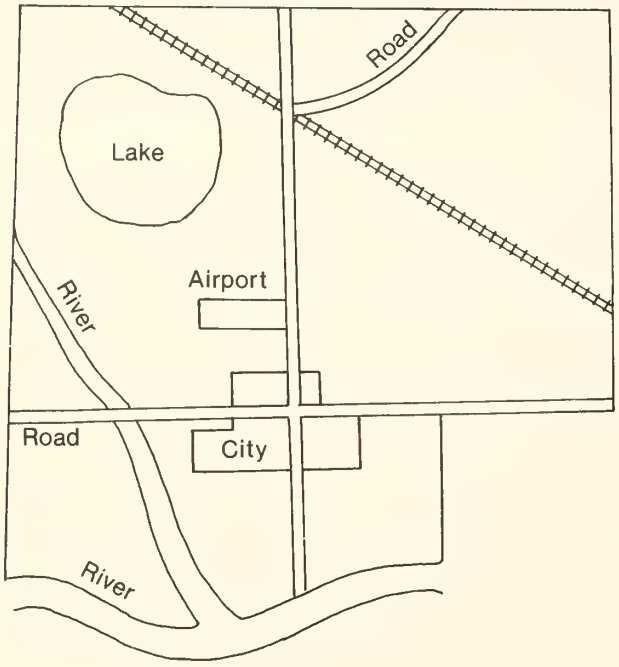
Since samples from the area frame will be used to collect information about many items of interest, the most important items must be identified. Some of the minor commodities become rare items, and an allocation determined for those items would be meaningless. Desired standard errors at the State level are established for each item and standard deviations by stratum are estimated based on previous survey data. An optimum allocation, that is, the number of segments to be sampled from each stratum, is obtained for each major commodity and over all the major commodities considered together. Several alternative allocations are evaluated for expected precision and expected number of interviews (including number of agricultural interviews), employing the criteria of least cost and greatest precision.

With the total sample size and strata sample sizes now established, the frame designers select a representative sample of PSU's for each stratum statewide. Segment boundaries need to be mapped only for these selected PSU's. The technique for selecting the representative PSU's is called "paper stratification." It increases sampling efficiency by creating substrata which reflect similar crop types or types of farming within a land use stratum. Paper strata are constructed by arranging the PSU's so "like areas" are ordered consecutively. Historically, the use of PSU listing forms to make this ordered arrangement gave rise to the name paper strata.

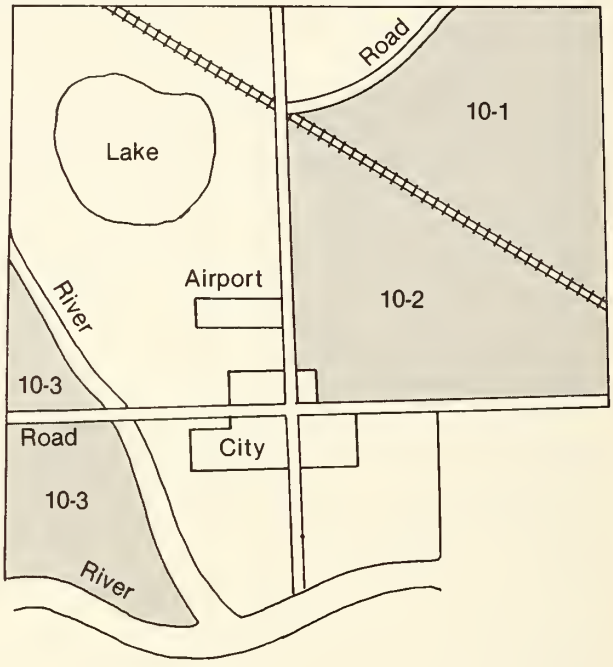
The rearranged PSU's are divided into groups with an equal number of segments. "Like areas" are thus grouped together, and at the same time geographic distribution of the sample (over counties or crop reporting districts) is ensured. Frequently, this distribution is achieved by numbering and ordering PSU's within a county, and counties within a stratum, in a serpentine fashion beginning in the northeast corner and proceeding from east to west. Since the number of paper strata determines the geographic distribution of the sample,

Figure 2. **Process Used to Select an Area-Frame Segment for a Typical County**

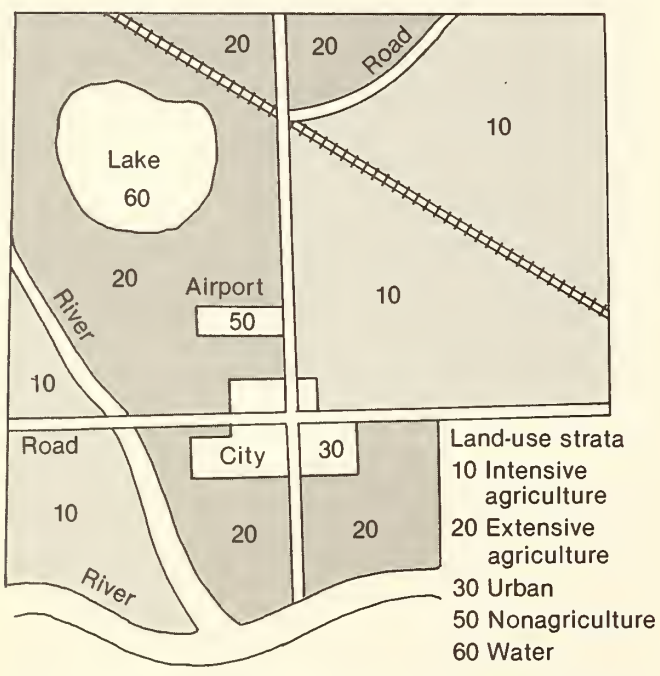
Typical county



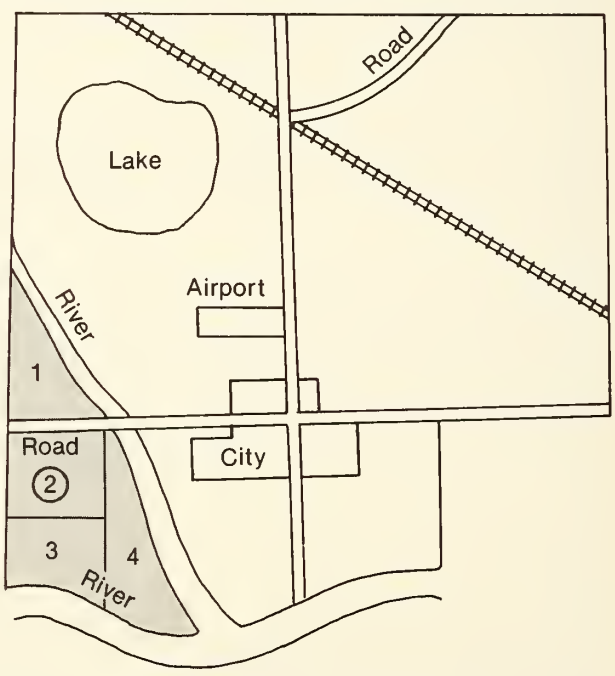
Step 2. Identify primary sampling units for Stratum 10



Step 1. Stratify county for land use



Step 3. Segment 2 selected from primary unit 10-3



knowledge of the frame characteristics acquired during the frame construction helps the statistician determine if there are important pockets of like areas.

After the PSU's have been assigned to paper strata, a sample is selected. Since the PSU's vary in size, they contain different numbers of potential segments. Therefore, the first stage of sampling is to randomly select a PSU from within each paper stratum with probabilities proportional to the number of segments within each PSU. The selected PSU's are located on photo indexes (a composite and photographic reduction of low-level, local-area aerial photographs) and are further subdivided into the predetermined number of uniquely identified segments.

The second stage of sample selection begins with a random selection of a segment from each selected PSU. As this process is repeated, all segments are assigned to "replicates." Usually, 10 to 20 such replicates are chosen. Each replicate is a small portion of the sample which could provide an independent estimate of the entire sample, although with less precision. Replicates permit SRS to rotate the sample segments surveyed each year, reducing the burden on respondents operating land in a sampled segment. In a typical survey five replicates (or a multiple of five) are used, so 20 percent of the segments are rotated each year. The replicates also facilitate adjustment in the sample allocation when necessary.

Photographic enlargements are obtained for the segments selected. The selected segment boundaries are copied onto the enlarged photograph and onto a county highway map for use by enumerators during the survey. This process is done for the entire sample the first year but only for segments rotated (20 percent of the sample) in each of the following years.

This completes the process of area-frame construction.

Maintenance

Certain problems are identified as the area frame is used for actual surveys and corrective action is taken to facilitate future data collection. Immediately following the June enumerative survey, all sampled segments are reviewed to identify any boundary or enumeration problems. Problems may result if segments are abnormally difficult to enumerate because of the segment size or if they contain too many agricultural tracts. Other problems occur when segment boundary lines are not well defined (cut through fields or farmsteads) or the segment boundaries are different on the photograph than they are on the county highway map. Action may be taken to correct these problems only if the selection probability can be adjusted without introducing bias. For example, an allowable action may be to divide the segment in half and double the expansion factor if an even distribution of agriculture (cropland, farmsteads, and so forth) is maintained.

List Frames

List frames have been used in SRS for many years. However, the number, kind, and quality of list frames maintained and used by the SSO's have varied considerably. Only in recent years have efforts been made to establish standards and develop sophisticated systems to construct, maintain, and use list frames. Since 1976, a standard system has been developed which each SSO uses to construct, maintain, and sample a general purpose list frame.

Construction

The goal of constructing list frames in SRS is to produce relatively complete, current, and unduplicated lists of names which can be used for sampling purposes. Since the first step in constructing a list frame is to assemble several lists from a variety of sources, identifying duplication between lists is a major problem. Names and addresses from all lists must be converted into a common format and duplication removed using a computer matching process.

This computer process is called "record linkage." For example, separate records (names and addresses in a computer file) which have slightly different spellings of surnames such as "Smith," "Smithe," or "Smythe" will be linked together if other information in the records is very similar. The record linkage procedure evaluates similar pieces of information for each name so that all records which potentially represent the same name are "linked" together. A statistical decision model relies on the frequency of occurrence of name, address, and identifier components, and the occurrence of certain types of errors within the file, to determine duplication.[1] The computer's decisions are manually reviewed.

[1] Ivan Fellegi and Alan Sunter of Statistics Canada developed the underlying theory. Ivan P. Fellegi and Alan Sunter, "A Theory for Record Linkage," *Journal of the American Statistical Association*, Dec. 1969, pp. 1183-1210.

The level of duplication which will remain in the file following the record linkage and manual review procedure is estimated prior to completing linkage. This is accomplished by randomly selecting a very small sample and determining the duplication which remains within the sample after executing the decision model on that sample under a stringent set of criteria. Criteria are then adjusted so that the amount of duplication which will remain in the new frame is less than 1 percent.

Once duplication has been eliminated, each name (unit) must be combined with control data that identify the commodities produced and size of the operation in terms of crop acreages, livestock numbers, and so forth. Control data can be obtained from a variety of sources such as the lists used to construct and update the frame, regular ongoing surveys, special surveys, local and State governmental agencies, and other Federal agencies. Since all farms do not produce the same commodities, it is important for sampling purposes to retain commodity and size data on the frame. When stratification is based upon a specific data item, the most important information is the presence or absence of that item followed by some measure of size. Generally, the better the relationship between the data used for stratification and the survey data collected, the smaller the sample size necessary to produce reliable estimates.

Sampling Process

After the duplication has been removed and control data are obtained and recorded, the list frame is ready for sampling. SRS uses a computer system capable of selecting samples based on various methods and designs—simple random, stratified, probability proportional to size, cluster, and replicated. Most of the sampling designs employed involve some type of stratification because of the tremendous gains in sampling efficiency compared with simple random sampling. In other words, sample sizes for achieving a specific precision can usually be greatly reduced when the universe is stratified.

A typical sample selection procedure for a commodity requires that a "frame of interest" be established for that commodity within the overall list frame. For example, a cattle frame is established by identifying names with control data indicating the presence of cattle. Names that do not have cattle control data are not members of the cattle frame. The classification process also assigns names to size groups (strata) based upon the relative size of the control data. For example, all extremely large units are assigned to a different stratum than extremely small units. An optimum allocation procedure distributes the list sample to the various strata. This means that strata containing large operators may be sampled much more frequently than those containing small operators.

Maintenance

Maintaining a list frame is very costly because units in the frame are constantly changing and lists are usually incomplete. The control data, which are extremely important to the sampling process, also change as farming operations change. Maintaining high quality control data requires a maintenance plan for obtaining current information for a large portion of the frame each year. Currently, the goal is to obtain information about each list-frame unit at least once every 3 years. If information is not obtained about a particular list-frame unit within the this period, the unit is removed from the active frames. Maintenance plans emphasize acquiring data on large farm operations, specialty operations, and agribusinesses.

The quality of control data obtained for use in the frame depends upon the source. Caution must be exercised when combining control data from several different sources. One of the best sources of control data for SRS purposes is responses to the large sample surveys selected by SSO's for county estimates and maintenance purposes. Maintenance of the proper control data also requires some knowledge of the commodities on the frame. For example, inventories of certain livestock species can fluctuate drastically within a calendar year; therefore, the control data required are often more than just the current number on hand. Conversely, since total land in the farm is one item of control which does not change much from one year to another, the most current report of the farm's acreage is sufficient for control data purposes.

Relatively small changes in control data levels from one period to another are usually unimportant for sampling purposes. However, changes from large values to small values, or the reverse, and introduction or elimination of a commodity, are extremely important with respect to sampling efficiency.

In summary, it is important to remember that the list frame is an incomplete frame while the area frame is complete, and that a list frame requires constant maintenance.

Estimation Methods

The remainder of this chapter explains the methods employed for the different types of surveys that SRS conducts, and how data gathered are converted into estimates. Chapter 3 will describe in detail how each survey is actually conducted.

The computations and procedures for translating survey data into estimates involve technical considerations. Usually more than one method is available, but the choices are largely specified by survey design. There are distinct differences between the ways estimates are derived from probability and nonprobability surveys.

Probability Surveys

Probability surveys are designed on the premise that every unit in the population has a known probability of being selected. The probabilities do not have to be equal, but they must be known and used in the selection and estimation processes.

Estimates can be made from probability surveys without depending on prior survey information or benchmark data. Because probabilities of selection associated with the sample units are known, data collected from them can be used to obtain unbiased estimates of current agricultural activities. Also, sampling errors can be computed for probability surveys, providing the statistician with a tool for evaluating the reliability of estimates. Sampling errors are also useful in optimizing sample designs and allocating future surveys. The quality of statistics derived from probability survey data usually justifies their higher cost.

The factors involved in evaluating survey reliability are the sampling frame, survey design, and sample size. Each is important in maintaining sampling errors at acceptable levels, although constraints on sample size are frequently imposed by budget limitations. Measures of nonsampling errors are rarely available except through special studies. Nonsampling errors are discussed in Chapter 12. SRS minimizes potential nonsampling errors through survey training programs, questionnaire design and testing, simiplified and uniform survey procedures, and comprehensive editing systems.

Area-Frame Surveys

The survey design must identify at an early stage what information is needed from respondents and what the reporting unit will be. Equally important, the survey questionnaire must clearly convey to the respondent for what unit the information is to be reported. The area-frame reporting units are the tract of land (closed-segment method) and farm (open-segment and weighted-segment methods).

Closed Segment. The tract is the area of land inside a segment under one type of land-operating arrangement. The segment may be divided into one or more tracts. The tract is, therefore, uniquely associated with only one segment. Sometimes, the respondent does not know the exact location of the item of interest, such as grazing cattle, with respect to the tract boundaries. Rules are required to ensure that the item is uniquely assigned to a given segment by prorating the item on the proportion of "tract acres operated" to the "total acres operated."

Open Segment. The second method uses the farm (total land operated) as the reporting unit. The operator's residence is used to uniquely associate every farm with only one segment. This concept refers to the total acres operated under one type of land-operating arrangement only if the residence of the operator is within the segment. Rules must be established to create a one-to-one correspondence between the farm operator and the farm reporting unit. For example, if two brothers operate jointly and live in two different houses, the rules must define which brother is the farm operator.

Weighted Segment. The third method, the weighted segment, requires collection of total farm data from every farm having land within, or partly within, a segment. The farm data are then weighted by the proportion of the total farmland that is within the segment.

Advantages and Disadvantages

Collecting data within the boundaries of a segment is a simple concept. It is also the primary advantage of having tract acres as the reporting unit. Most respondents know the acreage of individual fields that can be seen on a photograph and can accurately report those acres. Also, if the tract operator refuses to provide information or is not available for interview, the required data can be estimated based on observation and measurement. The primary disadvantage is that it is sometimes difficult for the respondent to report certain items of interest such as economic data (labor used, fuel purchased, and so forth) for just a portion of the total acres operated. Livestock that can freely move across tract boundaries pose a similar problem.

The main advantage of using total acres operated as the reporting unit is that the operator can report some types

of economic data more readily for the entire farm than for a part of the farm. Exact interpretation of the segment boundary is not relevant except for the location of the residence. However, the residence concept introduces problems of defining the operator, which may create duplication or omission. Estimation for operators not interviewed also becomes more difficult.

The weighted procedure avoids the definitional problem of determining the residence and may avoid data omission since farm data are always obtained. Some of the disadvantages are that individual farm data do need to be weighted and more interview time is required to obtain data within the segment and for the entire farm from all operators—not just resident operators.

Enumerative Surveys

In SRS, "enumerative survey" refers to a sample survey in which data are collected by personal interview. The basic estimator used for area-frame surveys is the unbiased direct-expansion estimate of the population total. Raw tract, farm, and weighted survey data from each segment are multiplied by the reciprocal of the probability of selection. Estimates are generally computed at the stratum level for analysis purposes, but inferences from enumerative survey data are seldom made below the State level because of relatively large sampling errors. Since segments are the sampling units, tract data must be summed to the segment level. Sampling errors are then determined from the variation between segments.

For the June Enumerative Survey (JES), ratios are computed by comparing current survey data with previous-year data for identical segments. Eighty percent of the segments are identical since 20 percent of the sample rotates each year. Ratios are computed at each level of summary to minimize biases inherent in ratio estimates. These estimates are particularly helpful in evaluating changes from survey to survey. The ratio estimate is derived by applying the ratio to the direct-expansion estimate from the previous year's survey. Estimated sampling errors take into account the correlation or covariance of the matched data.

Another estimator is derived using a ratio of the segment item total to the segment land area. This estimator is efficient for major crops and other items that are highly correlated with land area. The actual area of each segment is measured from a scaled aerial photograph. The relation of each item to the measured area is calculated and this ratio is applied to the total base land area at the State level to estimate the total for each item. All statistical concepts of ratio estimation apply; however, the base or total land area is assumed to be known without error.

The theoretical concepts associated with subsequent area-frame subsample surveys are more complex. All tracts from the JES are classified into "post" strata and then subsampled in followup surveys. Although it is a two-stage sample design, the second stage of sampling is not confined to the JES sampling units (segments) as would be the case in cluster sampling. Instead, the second stage of selection is among all tracts classified according to predetermined criteria using information collected in a prior survey. The basic post strata are as follows: tracts containing winter wheat in June, tracts containing livestock in June, agricultural tracts with no wheat or livestock, and nonagricultural tracts. With this sampling scheme, tracts will not be selected in all segments because of the small sampling fraction. Unbiased direct-expansion estimates can still be generated by associating the probabilities of selection (probabilities at the first stage of selection multiplied by probabilities at the second stage) with the data for each sampled tract. The difficulty arises in computing sampling errors because of the various levels of sampling involved. Exact estimation of the sampling variation requires computing separate variance estimates for the between-segment component and component of variance between tracts within post strata. Ratio estimators are also used for surveys based on subsamples of June area tracts. The ratios are computed by relating data from the current survey back to June data. The JES direct-expansion estimate becomes the base when computing this ratio estimate.

Multiple-Frame Surveys

A method of widespread importance and use in SRS surveys is multiple-frame sampling. As the name implies, this technique includes the use of more than one sampling frame. For SRS, this means using both a list frame and an area frame.

Theory for multiple-frame sampling was developed in the early sixties, when SRS supported research at Iowa State University under the leadership of the late Dr. H.O. Hartley. Concepts of multiple-frame sampling are basically those of probability sampling concerning representation, known probabilities, and randomness of selection. In addition, two criteria need to be considered. Every element of the population must belong to at least one of the sampling frames, and it must be possible to identify for each selected unit which frame, if any, it belongs to other than the one from which it was selected.

The use of a complete area frame satisfies the first consideration. The second is more difficult operationally, requiring identification of each area-frame tract operator who is also included in the list frame.

Uses, Strengths, and Weaknesses. Multiple-frame sampling has some distinct advantages for SRS, particularly for items such as livestock, specialized crops, and for economic data such as amount of labor. These items are poorly correlated with land area and are inefficiently estimated by the area frame. In multiple-frame sampling, most of the data for the population of interest can be collected more efficiently through the list frame by mail or telephone. Also, it is usually possible to develop and incorporate control data for units in the list frame for stratification and sampling purposes. The area frame also measures list incompleteness. In this way, the two frames complement each other.

Two similar multiple-frame approaches are used for estimation of livestock. One approach uses the list (with high sampling rates) just for extremely large operators and the area frame (with low sampling rates) to measure list incompleteness (usually referred to as nonoverlap). Here, the list incompleteness is primarily composed of small-area operators. The resulting estimate and particularly the variance is mainly from the area frame. Large operators are estimated from the list frame to reduce the sampling error. The June and December enumerative survey estimators use this sample design.

The second multiple-frame sampling approach uses a large list frame and a small area frame. Here, direct expansion and variance from the list represents a large proportion of the universe total. This procedure is used for the quarterly hog and January cattle multiple-frame surveys and provides more precise estimates than the above procedure.

Sample Allocation to Frames. The allocation of a multiple-frame sample is more complex than for a single-frame since data collection costs for the two frames are considerably different. Area-frame survey data can be divided into domains. Each domain corresponds to a list-frame stratum and the nonoverlap stratum. Each domain provides an estimate and coefficient of variation of the respective population.

This is extremely valuable in determining whether or not to sample from the entire list. The entire list is composed of names that may or may not have some index of size for the item of interest. Generally, the list frame strata with positive control data can be more efficiently sampled in terms of variance than by letting the area nonoverlap domain account for this respective population. This is primarily due to a higher rate of sampling from the list. Certainly, it is difficult to justify sampling a large number of list-frame operators to obtain just a few positive reports if the corresponding area records from an ongoing survey can provide an estimate with nearly equal or greater precision for less cost.

Estimation Procedures. The general estimation model for multiple-frame surveys based on a list and area sampling frame is:

$$X = X_a + pX_{al} + qX'_{al}$$

Where:

X_a = the estimated total for the portion of the population included only in the area frame;

X_{al} = the estimated total for the population included in both frames, computed from the area sample;

X'_{al} = the estimated total for the population included in both frames, computed from the list sample; and

$p + q = 1$.

Since X_{al} and X'_{al} are two independent estimates of the same population (overlap domain), any values for the weights p and q which sum to 1 will provide unbiased estimates. Optimum weights will be inversely proportional to the variances associated with each estimate. In practice, weights are predetermined utilizing information from prior surveys. For most surveys, values of $p = 0$ and $q = 1$ are used. This equation is often referred to as a "screening" estimator. The area portion of the estimated total may be based on any of three area-frame concepts (tract, farm, or weighted). All States have multiple-frame estimates where the area portion is based on both the tract and farm concepts from the June and December enumerative surveys. States in the quarterly hog and the January cattle multiple frame surveys use a weighted area (nonoverlap) estimator with the list frame including both small and large operators.

Little use has been made of ratios and ratio estimates in multiple-frame sampling. Direct-expansion estimates have proven to be efficient and allow complete flexibility in developing the sampling plan for each survey.

Overview of Procedures. Multiple-frame procedures are more complex than those for a single frame, primarily

because area names that are also on the list frame must be identified. If the area name is also on the list, it is overlap; and if not on the list, it is nonoverlap. All area-frame names associated with the tract are obtained on the JES questionnaire. These include the names of the operation, the operator, and each partner in a partnership. If there is no operation name or it is not on the list, the names of the operator and any partners must be checked against the names on the list frame. If any one of these names is on the list, the area name is overlap and the estimation for this unit will be based on the list frame.

Analysis

Outlier reports can influence survey expansions considerably. Outlier reports are sampled operations that report either very small or very large answers that lie apart from the rest of the reports. In practice, only the extremely large reports are of concern. These reports present problems if not detected. Detection is limited to identifying operators with large answers that vary from control data as opposed to identifying very small answers from operators with large control data. Outliers (both list and area frame) are first identified in the machine edit. List-frame outliers are identified again in a special analysis summary which excludes these reports. The summary is used to measure the outliers' impact. The statistician evaluates the sampling errors associated with each estimate, with and without outliers, when establishing a range for the final recommendation.

Objective Yield Surveys

Objective yield surveys provide information for making estimates or forecasts of crop yield based directly on plant counts, measurements, and weights of the crop obtained from small plots in a random sample of fields. When a crop is mature and ready for harvest, biological (gross) yield can be estimated by harvesting and weighing production from plots of known size and expanding to a gross yield per acre. This method of preharvest sampling to estimate yield is often referred to as "crop cutting." Similar procedures are used for tree crops, but gross yield is computed in terms of production per tree and observations are usually made on sampled limbs.

Gross yield overstates the production that is actually harvested and marketed. Harvesting loss must be deducted to compute net yield. To estimate all production remaining in fields, small sample plots are gleaned immediately following harvest.

Estimating yield becomes primarily a sampling problem when nonsampling errors are small. For a mature crop, samples can be designed to produce estimates of yield with any desired degree of precision.

Field Crops. Concepts and general methodology used in objective surveys for forecasting and estimating yields are similar for all field crops. Sample fields are selected from fields identified during a probability survey as having the crop of interest. A systematic sampling scheme, following a geographic arrangement of fields, is used to select sample fields. Observations are made on two randomly selected plots (units) in each of the selected fields. Plots for most crops include two adjacent rows of predetermined length. Self-weighting samples are selected by assigning probabilities of selection which are proportional to field acreages weighted by the reciprocal of the field's probability of being selected. This facilitates summarization because each sample unit has the same chance of selection.

Objective yield surveys are planned to coincide with the publication of production forecasts and estimates in the monthly *Crop Production* report. During the first survey month, crop maturity, established by defining five or six stages of development, varies considerably by region. Appropriate counts, measurements, and other observations are made for each sample that will be used in the forecast models. Plant characteristics measured and models used for prediction change as maturity progresses.

At an early stage, for example, a count of plants may be the only data available, but it is valuable in forecasting the number of mature fruit. If no characteristics are available to predict weight per fruit, historical averages are used. As the crop matures, other variables become important. Actual fruit counts are used, and weights and measurements of the immature fruit are often useful in predicting final weight per fruit.

Simple linear and multiple regression models are most often used to describe expected relationships between the prediction variables and the final observations at maturity. Typically, such data files for early-season counts and end-of-season harvest weights and measurements for each sample unit are paired. The preceding 3-year period is screened statistically for outlier and leverage data points. Once these atypical data are removed, the remaining data are used to create current forecast equations for maturity category models in each State. Forecasts of gross production are computed for each sample. Measurements are made to determine row spacing so that conversions to yield per acre can easily be

Objective measurements of growing crops help predict yields. At maturity, fruit are picked and weighed.

made. An adjustment is made for expected harvest losses based on past averages. Individual sample field yields are averaged to arrive at State estimates. Sampling errors are based on variation between yields derived for each sample field.

As the season progresses and crops mature, the individual sample yields provide data for estimates rather than forecasts. Final preharvest observations are made as near the date of harvest as practical. Similarly, it is desirable to do the postharvest work immediately following harvest by the farmer. When the information is available, actual harvesting losses are used to compute net yields.

Tree Crops. Sampling frames used to select blocks (fields) of trees have been developed by various means. In some cases, trade or marketing associations provide nearly complete lists of growers, classified by size of operation. Area frames have been constructed by identifying blocks of trees on aerial photographs. Stratification according to age of tree reduces sampling variability in some applications. In addition to its uses in sampling, the frame usually becomes the basis for estimating the population of trees.

Blocks of trees are sampled with probabilities proportional to the number of trees or acres; each method results in a self-weighting sample. Counts are usually made on two to four trees per block. Trees are selected randomly or in clusters. In the cluster method, one tree, a "pivot" tree, is selected randomly with additional count trees selected nearby. This cluster reduces counting time within the block.

The random-path method is often used for selecting count limbs within a tree. Beginning at the base and proceeding up the tree, a random selection is made at each point of branching until a count limb of suitable size is obtained. Probabilities proportional to the cross-sectional areas of the limbs are usually used in the selection process to gain sampling efficiency. An alternative to the random-path method is to select a primary limb as described, but to map out the remaining branches into suitable count limb sections. A random choice of one or more of these sections can then be used for counting purposes. On mature trees, 5 to 10 percent of the fruit on the tree is usually counted. The probabilities associated with each stage of selection must be used to convert the limb counts to an estimate of fruit per tree.

Once fruit is set, forecasting becomes the task of projecting fruit drop and growth. Both linear and nonlinear regression models are used for this purpose. Most droppage occurs immediately following bloom, after which the counts for number of fruit become relatively stable. Predicting weight of mature fruit is done by relating immature size or weights at specified stages of maturity to final weight. Drop and growth patterns observed in past surveys are needed to make current forecasts.

Periodic surveys are used to update the projections of fruit drop and growth until harvest. To estimate production harvested, an allowance must be made for fruit remaining after harvest. Since blocks are the primary sampling units, sampling errors of estimated production per tree are computed from variation between blocks.

Validation Studies. SRS conducts periodic studies to determine whether changes in technology, varieties, cropping practices, or operation sizes may require the modification of objective yield survey procedures.

Normally, a validation study is conducted in two to four States. About 50 fields are sampled in each State. Each sample field is assigned enough sample plots to produce reliable estimates of yield. Standard survey measurements, edit procedures, and summary procedures are applied to each plot to determine harvested production estimates for each field.

This objective yield production estimate is compared with the true production when the operator harvests the field. True production is obtained by weighing each load hauled from the field at a nearby elevator. A field enumerator records the weight and moisture measurements taken by the elevator operator. After the operator harvests the field, one harvest loss plot is counted for each preharvest sample plot. The final component, acreage, is obtained in cooperation with the Agricultural Stabili-

zation and Conservation Service (ASCS). ASCS takes low-altitude photographs of every field in the study. Field boundaries are drawn on these photographs and the exact field acreages computed in a process called "digitization."

Using these components, net yield or production from the objective yield survey is statistically compared to that obtained by the farm operator. If indicated from these results, current survey procedures can be modified to reduce bias or improve sampling procedures.

Nonprobability Surveys

Nonprobability surveys are voluntary mail surveys based on incomplete frames. Nonprobability surveys tend to be selective, employing operators known to have had the commodities of interest. Operators who are willing to cooperate are asked to supply data relating to their own farms as well as data relating to agricultural conditions in their locality.

Voluntary mail samples fall into three categories:

- General crop questionnaires are sent to regular reporters at the first of each month during the growing season. Reporters are asked to give their judgement for the locality on crop and pasture conditions and yields per acre. Individual farm observations are collected on quarterly farm stocks.

- A sample of farm operators selected from a list frame receive crop acreage questionnaires in February on intentions to plant, in June on crop acreages planted and for harvest, and in late fall on actual acreage harvested and on production. In many States, the regular monthly reporters are also included in these individual farm inquiries.

- Special-purpose samples are conducted to make forecasts and estimates of acreage, condition, yield, or production of some important commercial crops, poultry numbers, and other items for which an adequate sample cannot be obtained by general-purpose sampling.

Procedures for making estimates from data obtained in nonprobability mail surveys must account for potential biases in the survey results. The procedures used for removing bias generally depend on past relationships between survey data and final official estimates. Periodic checks must be made to verify that these historical relationships remain valid. Check data are obtained from a variety of sources, including records of marketings, information from current SRS probability surveys (for major crops), and the U.S. Census of Agriculture (for minor crops).

Many factors affect the reliability of estimates derived from nonprobability surveys. First, it is necessary to evaluate the accuracy of the check data used to establish the relationships derived for past years. Second, past observed relationships of survey data to final official estimates may no longer be valid. If survey indications for past surveys are based on selected data, indications used to make the current estimate must be subject to the same kind of selectivity for best results. Therefore, comparability of the list samples, sampling procedure, sample distribution, and the survey response should be considered.

Survey Indications

It is not possible to obtain accurate direct estimates of population totals with nonprobability surveys because of incompleteness of the list frame used to collect the data. Therefore, most survey indications are relationships estimated from the survey data which can be applied to some assumed known base. Brief descriptions of some of the commonly used nonprobability survey indications follow.

Ratio to Land. The sample total acreage for a specified crop is divided by the sample total farmland acreage or total cropland acreage. This provides a measure of the proportion of farmland acreage used for that crop. The relationship of any two items on the questionnaire can be estimated in this manner.

Ratio to Base. This indication is similar, but the control variable, such as capacity of feedlots, hatcheries, or grain storages, is known in advance and is part of the sampling frame. The ratio estimated from the sample totals can be expanded by the known base totals for the population.

Average per Farm. Averages per farm estimated from survey data are used to estimate some minor livestock items. These averages can be expanded to universe totals using the number of farms estimates with the livestock item. Averages obtained from mail surveys can be quite biased because the proper distribution of farm sizes may not be accurately represented among survey respondents.

Matched Reports. Estimates of survey-to-survey changes are made by matching reports from the same farm for two successive surveys. This indication is commonly called the "current/current" (C/C) ratio. Indications are developed by applying survey changes to the previous estimates. Care must be taken in the matching process to assure that the reporting units are comparable between surveys. The procedure does not permit new operating units to be included in the tabulations.

A variation of this procedure is the "current/historical" (C/H) indication, which also measures change from some previous period, but data for the prior period are collected on the current questionnaire. For example, a farmer would be asked to report the previous year's production of each crop along with current year's stocks. The advantage is that all reports can be used for tabulation and no matching is required. It has been found that the data reported by farmers for the preceding year are often subject to error because of memory bias or other reasons.

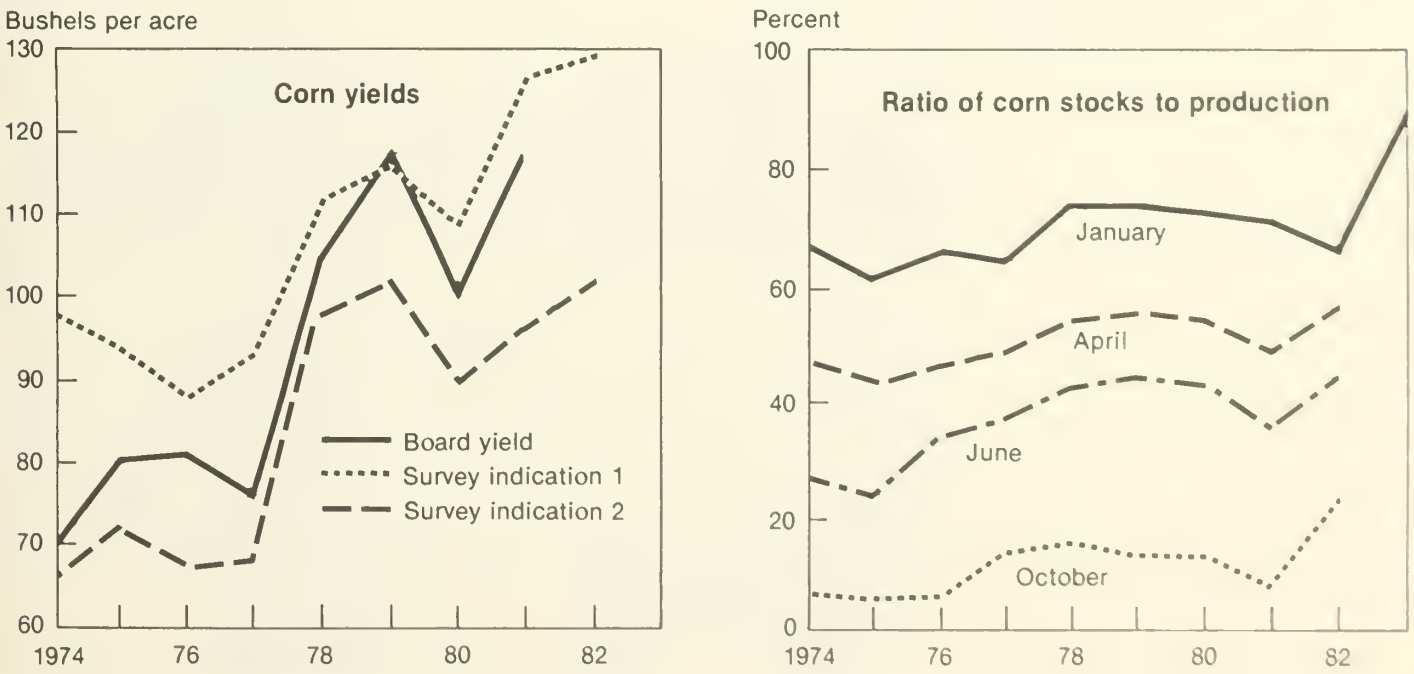
Yield Indications. Mail surveys have retained much of their usefulness for estimating and forecasting crop yields. Indications for forecasting yields are based on reports of condition or probable yield. Reported condition consists of evaluations by growers and crop reporters of the size of the current crop expressed as a percentage of a hypothetical full or normal crop. Expected or probable yield is likewise a subjective judgment of crop prospects, but is expressed directly as yield per acre. At harvest, actual yields can be derived by obtaining harvested acreage and comparable production data.

Data Interpretation

The assumptions that must be made to prepare estimates from nonprobability survey indications are factors that limit survey reliability. Several methods most frequently used for minimizing or interpreting the inherent biases should be mentioned.

Weighted Averages. One procedure for minimizing response bias is to summarize the data by geographic or size group strata. Known or estimated weights are used to weight stratum averages to State estimates. The effect of a poor distribution in sample response is minimized, providing respondents have characteristics similar to others in the same stratum. For example, crop yields would normally be expected to be more alike within a crop reporting district than within an entire State. Average yields from the survey are computed at the level of

Figure 3. **Examples of Time-Series Charts Used to Estimate a State's Corn Yield and Stocks of Corn on Farms**



the crop reporting district and weighted to a State average yield using district estimates of crop acreages for weights. Size group stratification is used similarly.

Charts. Most nonprobability survey data are interpreted through time-series charts which pictorially describe past relationships of survey indications to final estimates. The horizontal axis is used to sequentially plot time. The levels of indications and values of the board estimates are indicated on the vertical axis. Indications and the corresponding estimates are distinguished by different types of points and lines drawn to show respective year-to-year changes. The chart enables statisticians to evaluate all indications simultaneously. More reliable indications can be given more weight in the evaluation process. Figure 3 shows time-series charts used to estimate corn yields and corn stocks.

Trend is an important consideration for some estimates, particularly in developing crop yield forecasts. Time is often used as a second variable for developing a multiple-regression indication. In this way, an allowance for trend (due to improved variables, cultural practices, or fertilization) is incorporated into the indication. Additional variables, such as precipitation, are occasionally used in developing the multiple-regression indication.

Preparation of Estimates

The preparation of official forecasts and estimates represents the combined effort of both the SSO's and the Washington, D.C., staff. Sample data are collected and reviewed in the SSO's. Some survey data are also summarized by the SSO's. However, most probability survey data are summarized on the computer network, with State-level summaries printed in the SSO's. State statisticians prepare the initial forecasts or estimates for their States and transmit them with supporting data and comments to the CRB in Washington. An explanation of unusual local conditions or other pertinent information affecting an estimate is provided in the statistician's comments.

In Washington, statisticians summarize State data for each item to national totals. CRB members convene to review and adopt the official estimates for all major commodities, including livestock species and crops identified as speculative. The Board includes members who are commodity specialists for the commodity being estimated. Each member makes an independent interpretation of all available data and recommends an estimate. The chairperson reviews these recommendations and reconciles differences of opinion.

For most commodities, a national estimate is determined first, then individual State estimates are established. This procedure permits the use of check data such as slaughter records or exports, and survey information available at the national level. For example, the probability survey data indications have less sampling variability at the national and regional levels than at the State level. The probability survey indications are also very important in establishing estimates at the State level, although the relative sampling errors are larger than those obtained at the regional and national levels.

Chapter 3

Methods of Collecting and Processing Data

Introduction

The SRS data collection program consists of a series of surveys producing current agricultural statistics on acreages, yield, and production of crops; livestock and poultry inventories; prices received by farmers for commodities produced; prices paid for inputs used in production; and other information pertaining to the agricultural economy.

SRS survey methods have changed significantly during the past quarter-century. Almost all SRS-published statistics prior to 1960 were based on nonprobability mail surveys, which depend on subjective responses to questionnaires. Since then, SRS has increased use of probability surveys, which use objective and enumerative data collection. Nonprobability mail surveys are used today mostly to supplement major probability surveys.

Data Sources

The most important survey data sources are farm or ranch operators who voluntarily supply information about their operations. Only a small fraction of the Nation's agricultural producers are usually selected for a single survey. Some may be in a small, preselected probability sample from which responses are collected by personal interview, telephone, or a mailed inquiry. Others may be included in a larger sample of farm or ranch operators in which only mailed responses are used.

Data also are collected from agribusiness firms and merchants serving agriculture. Suppliers of agricultural inputs and purchasers of raw farm products are important sources for developing statistics on agricultural commodities and inputs used in production. These firms can often provide valuable data on quantities marketed or processed, which are used as check data to revise earlier estimates made from sample surveys. Data from these sources are especially useful in verifying nonprobability mail survey results.

Valuable data are also obtained through private and government agencies and trade associations by cooperative agreement or other arrangement with SRS. Examples include the Bureau of the Census, U.S. Department

Information volunteered by farmers and ranchers is the most important data source for crop and livestock estimates. Here, enumerator interviews farmer to determine cropland usage. Data gathered from a small, randomly selected sample of farmers is used to make accurate State and national estimates.

of Commerce, and State departments of agriculture, which conduct farm censuses; producer associations; railroads; irrigation projects; and financial agencies serving farmers. Data from administrative records, such as total marketings, shipments, or quantities processed, are sometimes available from these sources. The U.S. Census of Agriculture and State farm censuses are especially useful in preparing estimates for counties or other geographic areas within a State.

Data Collection

SRS attempts to minimize inaccuracy at each stage of data collection. Procedures for making surveys and processing data are established and documented in manuals. These procedures are designed to avoid potential problems in interviewing and taking field measurements. The initial data collected during a survey are reviewed to spot and correct difficulties at an early stage. Additional quality control procedures are implemented following major surveys to evaluate the results.

The four principal types of data collection surveys are mail, enumerative, multiple-frame, and objective measurement. The two methods of survey design are probability and nonprobability. Most mail surveys are of nonprobability design. Enumerative, multiple-frame, and objective measurement surveys employ probability survey design techniques. Chapter 2 explains the method that each type of survey employs. This section explains the procedures used to conduct them.

SRS uses the following procedure for enumerative, multiple-frame, and objective measurement surveys. Each SSO appoints one of the regular professional statisticians as State supervisor for surveys. Supervisors are trained at national schools for major surveys and are responsible for training NASDA supervisory and field enumerators in their States. SRS annually trains about 1,700 enumerators to conduct personal and telephone interviews. At least 30 enumerators are usually employed on a part-time basis in each State through a cooperative agreement with NASDA. They are located throughout the State to expedite data collection and minimize travel and expense. Most enumerators are local farmers, members of a farm family, retired rural residents, or other persons with an interest in agriculture. Enumerators are part-time employees with broad differences in age and education. They are trained for a few days prior to the survey and receive additional supervision while in the field. Many enumerators have long experience, some more than 25 years. Enumerators are expected to be familiar with the purpose of and need for each survey, to understand survey concepts and procedures, and to have knowledge of the survey forms and questionnaires to be used.

Mail Surveys

Mail surveys have long played an important role in SRS data collection. They are used to make current estimates of crop acreage, production, disposition, and stocks; to indicate weekly development of crops during the growing season; to obtain forecasts of yield; to make estimates of prices received and paid by farmers; and to formulate estimates of livestock and poultry inventories and production. The principal advantage of the mail survey is the relatively low cost compared with interview methods used in enumerative surveys.

A deficiency of mail surveys is that a significant number of those who receive questionnaires do not respond. Sending a second questionnaire or a postcard reminder a week or so after the initial mailing increases response. Also, statisticians interpret mail survey data with linear-regression and time-series charts to adjust for bias created by nonresponse and nonprobability survey design (see Chapter 2).

For probability mail surveys, SRS generates unbiased estimates for the nonresponse group either by a complete enumeration of nonrespondents (where the sample is small) or by subsampling nonrespondents and enumerating all operations in the subsample. Both telephone and personal interviews are used to account for the mail nonresponse.

Mail surveys ask farmers to report data relating to crop acreage, yield, and production on their own farms and subjective evaluations of general agricultural conditions reflecting neighboring farms as well.

Responses relating to a farmer's own operation are considered more accurate than locality judgments for most data. Locality questions are limited to those items about which a farmer has informed knowledge, such as general crop conditions. It was formerly believed that this technique would give a more representative picture of changes in crop acreages, livestock inventories, and other items. However, a farmer's lack of exact information about acreages and livestock numbers on neighboring farms makes locality answers on these and other items less reliable. Locality judgments are most helpful for early-season crop forecasts when farmers may be reluctant to speculate about actual yields expected but can judge the general crop condition.

Development of lists for mail surveys has not followed mathematical principles of sampling. Prior to 1960, emphasis was placed on obtaining responses from a range of persons who produced the commodities being surveyed, were believed to be well informed, and would report regularly. For general-purpose surveys, such as the monthly farm report survey, an additional requirement was that reporters be almost uniformly distributed over the agricultural areas of the country. The names of knowledgeable farmers who might be prospective reporters were often obtained from key individuals in selected areas of the State or through contacts made by the statisticians.

The Era of the Mail Survey

Large-scale nonprobability mail surveys were a satisfactory means of obtaining agricultural data when U.S. agriculture was much less specialized than it is today. The relatively large group of nonrespondents did not pose a serious problem. Since most neighboring farms grew the same crops and frequently had similar livestock and poultry inventories as well, characteristics of respondent and nonrespondent farms were not greatly different. However, as farms became larger and more specialized, nonprobability mail survey techniques became less reliable, particularly for livestock, poultry, and other specialty commodities, because respondent and nonrespondent farms were likely to be dissimilar. Alternative methods of data collection were necessary as emphasis shifted from sole reliance on large-scale nonprobability mail surveys to greater dependence on more scientific survey procedures.

Mail surveys are cost effective and useful for measuring agricultural characteristics that are common to many farms, where the variability of the data to be reported is limited, and where the survey period is restricted. Examples are crop surveys, particularly those relating to crop conditions, yield, or planting intentions. Surveys for more specialized data require adequate followup procedures for reliabile results.

During the late sixties and in the seventies, annual farm censuses, conducted in some States by local assessment officials in cooperation with the SRS State statisticians, provided excellent master lists of names. As data processing technologies and cost permitted, SRS created and maintained a directory of producers to support full probability sampling concepts. Names of prospective reporters are obtained from county agents, lists compiled in connection with USDA production control and conservation programs, and membership directories of trade organizations, such as fruit growers' associations. State license and inspection records and similar materials are also used as sources of names, particularly for those of agricultural manufacturing and processing plants. All lists compiled by SRS are used for statistical purposes only and are not available to the public.

Enumerative Surveys

The enumerative survey method requires collection of survey data pertaining to specific sampling units. These sampling units may be selected areas of land (area frame) or names selected at random from a commodity list of producers (list frame). These selected units must be uniquely identifiable and not subject to duplication by others who could also report for the same operation, if selected.

Sampled land areas (segments) often include only portions of identified farming operations. For this reason, the area-frame survey does not lend itself to collecting data by mail. In addition, operators of land within these segments are usually not identified in advance. Obtaining survey data through personal interviews is expensive but provides uniform data collecting and handling procedures for all SSO's to ensure quality regional and U.S. statistics.

June Enumerative Survey

The June enumerative survey (JES) makes extensive use of an area-frame sample. This survey is conducted annually during the last week of May and first week of June in the 48 conterminous States. Data collected for

SRS reports concern crop acres and land use, livestock inventory numbers, births of pigs and cattle, farm numbers, and related economic factors.

About 16,000 area segments in the Nation are enumerated. The number and size of segments vary by State according to land area, intensity and diversity of land use, and importance of each State's agriculture to U.S. estimates. Most Midwestern States have about 350 segments and Southern States have 450. Texas and California, each with more than 800 segments, have the largest samples.

All land within the sampled segment must be accounted for and its use identified. These segments include more than 120,000 separate operations (tracts). Each tract represents a different operator who is contacted in person for current information. About 60 percent of these tracts have agricultural activities.

A special list of large hog and cattle operations is also sampled and tabulated as part of the JES to maximize the sampling efficiency and improve estimates. Designated SSO's also have developed specialized lists of potato and rice producers for similar purposes. Selected list sample operators are usually mailed a special questionnaire. Nonrespondents to the mailed request are contacted by telephone or personally interviewed to account for the entire sample.

December Enumerative Survey

The December enumerative survey (DES) is conducted annually during the last week of November and the first week of December in the 48 conterminous States. Operators of more than 25,000 tracts (a subsample of all JES tracts) are personally contacted and information related to their operation is obtained. A list of large hog, cattle, and chicken producers is also sampled and data are collected from about 20,000 of them. These large producers are mailed a questionnaire; those not responding are contacted by telephone or personal visit.

The DES emphasizes collecting information for estimating livestock and poultry inventories, pig and cattle births, deaths, and number of head butchered for home consumption, plus acreage of fall-seeded wheat and rye. The survey is also used to estimate incompleteness of farm operator lists in the 29 States with multiple-frame livestock surveys.

Multiple-Frame Surveys

SRS has developed many applications for multiple-frame techniques which follow principles of probability sampling. The use of a list frame which represents a significant portion of the universe of interest makes it possible to collect much of the data inexpensively by mail. Telephone interviews are widely used to obtain data from nonrespondents and to clarify questionable data submitted by mail. Questionnaires are designed so that the respondent will include all items of interest on land operated, without regard to their ownership. Special questions are used to assist in defining the operator's unit in terms of the land operated. Names of all other individuals with an interest in the operation are requested so that duplication in reporting livestock can be avoided. Personal interviews are limited to area-frame samples and respondents who cannot be reached by telephone.

Livestock Surveys

Multiple-frame methods were used in livestock surveys starting in 1967 to provide cattle and hog estimates with sampling errors of 1 percent or less at the U.S. level. These methods resulted in improved reliability of State estimates over those obtained from either area-frame surveys or nonprobability mail surveys.

Additional States were included in the program as funds permitted; by 1974, 14 States were involved in the hog multiple-frame program and 28 States in the cattle multiple-frame program, representing 85-90 percent of the U.S. hog and cattle inventories. Under these programs, data are collected each quarter (March 1, June 1, September 1, and December 1) for hogs and on January 1 for cattle. Program reductions in 1982 discontinued a July 1 cattle multiple-frame survey and reduced quarterly hog coverage from 14 to 10 States. A multiple-frame survey was conducted annually in the 4 States deleted from the quarterly program.

All States use trained telephone enumerators at a supervised central location to interview mail nonrespondents. Those in the sample who do not respond by mail and cannot be contacted by phone are interviewed in person.

Farm Production Expenditures Survey

The farm production expenditures survey (FPES) is conducted annually in the 48 conterminous States during February and March. The survey questionnaire includes

considerable detail on production practices and costs and is more complex than most SRS surveys. All data are collected by personal interviews and pertain to the previous year's expenditures.

The basic area-frame sample used for the FPES includes about 4,700 area segments. The number varies by State according to land area and importance and diversity of agriculture. All resident farm operations in the area segments are interviewed. A list of farm operations in each State is also sampled. These farm operations are selected based on their value of production or hiring of employees.

Agricultural Labor Survey

The agricultural labor survey also uses a list frame in conjunction with the area frame. The list is composed of known employers of agricultural workers. In addition to measuring the incompleteness of the list frame, the area frame is used to estimate the number of paid and unpaid family members doing agricultural work.

The area-frame sample is selected from area segment operators interviewed during the FPES and classified as nonoverlap with the labor list frame. One questionnaire version is used to interview respondents from both frames. Questionnaires may be mailed to operators in the area frame. A telephone or personal interview is necessary for nonrespondents. Personal interviews are used for operators in the list frame since this sample usually includes larger and more complex operations.

Onfarm Grain Stocks Surveys

Beginning in April 1983, a quarterly onfarm probability grain stocks survey was started in 23 selected States which are major producers of corn, barley, oats, sorghum, soybeans, wheat, and rice. Sunflower stocks were added in October 1983. Hay stocks are surveyed annually in January. This survey uses multiple-frame procedures. A list sample, stratified by commodities produced and total cropland acreage, is contacted by mail and personal interview for each survey. JES area tract operations that are not on the list are surveyed to measure list incompleteness.

Livestock Prices Received

Entire-month indications for livestock prices are obtained from the probability livestock price survey. Auctions, dealers, and packers in 37 States are surveyed for data on actual transactions made by farmers selling cattle, hogs, and sheep. These States account for about 90 percent of the U.S. marketings for these species. Data collected by enumerators include the number of head sold, total live weight, and total dollars received by the farmer for each species. The data are expanded and summarized at the State level for total hundredweight marketed and the average price received by farmers. State prices are weighted to a U.S. average price using the expanded marketings.

Respondents in the sample are drawn proportional to size (that is, number of head handled annually) from a list of all known auctions, dealers, and packers in the State. All firms in the sample are surveyed each month until a new sample is selected, usually about every 3 years.

Grain Prices Received

Prices farmers receive for grain crops are estimated by a probability survey of mills and elevators. The eight crops collected by this monthly survey are corn, soybeans, oats, barley, flaxseed, wheat, grain sorghum, and sunflowers. Thirty-five States make monthly estimates of prices farmers receive for one or more of these crops. States included in the monthly price program account for about 90 percent of all U.S. sales for each commodity. Probability grain-price surveys were first implemented in 1977.

The universe for the grain prices survey is a list of mills, elevators, and warehouses that purchase grain from producers in each State. The lists are stratified into size groups according to capacity. A sample is systematically selected from the stratified universe in each State. About 2,300 mills, elevators, and warehouses are selected from a total universe of about 14,000.

The questionnaire asks for total quantity of each crop purchased during the previous month, and the total dollars paid to the producers for that quantity. This procedure allows weighting prices by the quantities sold. Data are collected by mail, telephone, and personal enumeration.

Objective Measurement Surveys

Although crop acreages for specific commodities change from year to year, some of the largest variations in crop production are caused by fluctuations in the yield per acre. For the better part of a century, yield forecasts were based on voluntary producer appraisals of expected yield. This survey procedure generally produced

satisfactory crop forecasts and continues to be used. However, large yield variations (particularly those forecast early in the growing season) are often not fully reflected in growers' subjective appraisals. This problem led to the development of objective methods to forecast and estimate yields of major crops. Objective procedures include actual counts and measurements of plant characteristics in sample fields by trained enumerators and laboratory analysis of fruit from the crops. SRS conducts a national program of objective yield surveys for corn, cotton, potatoes, soybeans, and wheat.

A sample of fields enumerated in the June or December enumerative survey is selected for making counts and observations. All fields planted in a crop have a theoretical probability of selection proportional to their acreage, so this sampling procedure provides a self-weighting sample which simplifies estimation and summarization. The location of plots within the fields is determined in a random manner before entering the field so that all areas of the field have equal probabilities of being selected and potential biases are minimized.

Counts and measurements are conducted during three basic crop development periods. During the first period, plants characteristically make rapid growth and fruit development is generally absent or in a very immature stage. The second period is midseason when plant output is in transition from vegetative growth to fruit development. The plant function is directed strongly toward fruit development during the final period. Plant counts and measurements vary by stage of development and correspond to plant characteristics used in the forecasting and estimating model.

Objective yield estimates must be adjusted for harvest loss. The loss is measured by hand-gleaning small plots.

The sample plots are harvested by the enumerator just before the farmer harvests the field. The gross yield per acre for the sample is computed. The enumerator gleans the plot after harvest. Harvest losses are subtracted from the gross yield to determine net yield for each sample.

The objective yield measurement program has become a vital, strengthening factor in improving monthly production forecasts and estimates throughout the crop season. There is a continuous effort to improve procedures, simplify forms, and update methods to keep objective yield surveys responsive to the continuing changes in crop production.

Questionnaire Design

Questionnaire design, like survey and estimating procedures, changed in the sixties to keep pace with a more specialized agriculture. At one time, because most farms were general in type, it was efficient and appropriate to use a broad-based series of questions relating to livestock or crops and send the survey forms to a large number of reporters. Their responses provided adequate data for statisticians to make estimates. Specialization in farming and ranching altered this data collection approach and prompted development of more sophisticated surveys and questionnaires.

Most livestock and poultry surveys used today are targeted for a specific species. Figure 4 is a cattle questionnaire used to collect data; there are similar ones for hog, sheep, chicken, turkey, and dairy surveys.

Crop questionnaires group field crops, grain, and hays together (fig. 5); fruit and vegetable questionnaires are separate.

Questionnaires used for interview surveys are highly detailed (fig. 6). For example, the JES requests data about crop acreages for specific fields within individual farm units. Other questions obtain data about irrigation, idle cropland, and number of crops harvested from a single field.

The most recent livestock and crop questionnaires also reflect SRS efforts to specifically identify the land operated by the respondent (fig. 7). These details enable SRS to identify and eliminate duplication of names and land operations that occur between the list and area frames in multiple-frame sampling. This prevents double counting of data which would distort the estimates.

CATTLE AND CALVES INVENTORY

Please report below all **CATTLE** *and* **CALVES,** *(including those on feed), regardless of ownership, on the land you operate. (Also include those owned or managed by this farm or ranch,that are now located on public, industrial, or grazing association land on a per head or AUM basis.)*

3. **BEEF COWS** *(Include heifers that have calved)* 351

4. **MILK COWS,** whether dry or in milk *(Include milk heifers that have calved)* 352

(Skip to Item 5, if no milk cows)

4a. **COWS MILKED** yesterday . . . . . **Number** 349

4b. **MILK PRODUCED** yesterday *(Report only one day's production)* . . . . . **Pounds** —**OR**— **Gallons** 501 / 502

4c. Total quantity of **GRAIN** and other **CONCENTRATES** fed **YESTERDAY** to **ALL MILK COWS** *(Both dry and in milk)* . . . . . **Pounds** 375

4d. Market value of grain and other concentrates fed yesterday to milk cows . **Per 100 Pounds** 376 — $. — —

4e. Average price per head of milk cows for dairy herd replacement in your locality . . . . . **Dollars** 514

5. **BULLS** weighing 500 pounds or more 353

6. **HEIFERS** weighing 500 pounds or more. . . .
   a. For **BEEF COW** replacement *(Exclude heifers that have calved)* 354
   b. For **MILK COW** replacement *(Exclude heifers that have calved)* 355
   c. **OTHER HEIFERS** weighing 500 pounds or more . . . . . *(Exclude heifers that have calved)* 356

7. **STEERS** weighing 500 pounds or more 357

8. **HEIFER, STEER** and **BULL CALVES** weighing less than 500 pounds 358
(Include newborn calves)

9. **TOTAL** number of **CATTLE** and **CALVES** *(add Items 3 through 8)* 350

9a. Are any **CATTLE** and **CALVES** on land you operate in another State?

☐ **YES** · *Include these cattle and calves on this report.* ☐ **NO** · *Continue*

Figure 4. **Portion of a 1983 Survey Questionnaire for Obtaining Cattle Information**

Crop Reporting Board

Statistical Reporting Service

U.S. Department of Agriculture

JUNE 1983 ACREAGE SURVEY

Form Approved
O.M.B. Number 0535-0029
C.E. 02-9744

North Dakota

Dear Reporter:

The information asked for in this survey is used in preparing estimates of crop acreages for 1983. Response to this survey is voluntary and not required by law. However, your report will be very helpful in representing your locality.

Please return promptly in the enclosed envelope which does not require a stamp. If exact acreage is not known, please give your best estimate. Your report will be kept confidential.

Respectfully,

Robert F. Carver
Statistician In Charge

Please make corrections in name, address and Zip Code, if necessary

REPORT ONLY FOR THE OPERATION LISTED ABOVE

INSTRUCTIONS: Include land rented from others but exclude land rented to others.

CROPS	Acres planted for all purposes *(Include total fall and spring plantings for the 1983 crop).*	Acreage which have been or will be harvested for grain in 1983 *(Enter small grain cut for hay in "All other hay" below).*
Winter Wheat	680	685
Rye	470	473
Durum Wheat	775	780
Spring Wheat *(other than Durum)*	740	745
Oats for all purposes	385	388
Barley	001	006
Flax	270	273
Millet for all purposes	870	872
		Acres planted or to be planted in 1983
Corn for all purposes		130
Soybeans for all purposes		625
Mustard *(type _____)*		910
Potatoes		435
Sugarbeets		649
Dry edible beans *(pinto, navy and other varieties)*		227
Sunflowers: Oil varieties		876
Non-oil varieties		877
Other spring planted **crops** _____ *(name crop)*		897
		Acres to be cut for hay in 1983
Alfalfa and **alfalfa mixtures**		286
All other hay *(include wild, marsh, and prairie, grains, bromegrass, timothy, millet, red clover, sweetclover, Sudan and sorghum X Sudan crosses to be cut for hay)*		316
		Acres in 1983
Cropland idle and in summer fallow *(not used for crops or pasture)*		965
Pasture and rangeland		961
All other land *(idle, etc.)*		960
ACRES OF ALL LAND IN THIS OPERATION		995

Reported by _____ County _____
(In which farm is located)

Figure 5. **A 1983 Crop Acreage Questionnaire Requesting Planted Acreage Data**

SECTION A — ACREAGES OF FIELDS AND CROPS INSIDE BLUE TRACT BOUNDARY

How many acres are **inside** this blue tract boundary drawn on the photo *(or map)*? . . . . . Acres

Now I would like to ask about each field inside this blue tract boundary and its use in 1983.

FIELD NUMBER.	827 1	827 2	827 3	827 4	827 5
1a. Total Acres in Field	828 .	828 .	828 .	828 .	828 .
2. Crop or Land Use *(Specify)*					
3. Occupied Farmstead or Dwelling	843 .				
4d. Non-Crop Land Cover (Fld. generally 3 + ac.) (Line 4d must = Line 1)	— — — .	— — — .	— — — .	— — — .	— — — .
4e. Cropland Waste (Generally ◄3 ac.) (Record water on Line 4d)	829 .	829 .	829 .	829 .	829 .
5a. Pasture — Native — Not in crop rotation	871 .	871 .	871 .	871 .	871 .
5a. Pasture — Cropland — Used only for pasture	856 .	856 .	856 .	856 .	856 .
5a. Pasture — Other — Not native or cropland pasture	892 .	892 .	892 .	892 .	892 .
6. Two Crops Planted in this Field for harvest this year or two uses of the same crop?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
	844 .	844 .	844 .	844 .	844 .
7. Acres Left to be Planted?	61_ .	61_ .	61_ .	61_ .	61_ .
8. Acres Irrigated and to be Irrigated?	6_ _ .	8_ _ .	6_ _ .	6_ _ .	6_ _ .
11. Winter Wheat — Planted	540 .	540 .	540 .	540 .	540 .
12. Winter Wheat — For Grain	541 .	541 .	541 .	541 .	541 .
15. Oats — Planted and to be planted	533 .	533 .	533 .	533 .	533 .
16. Oats — For Grain	534 .	534 .	534 .	534 .	534 .
19. Corn — Planted and to be planted	530 .	530 .	530 .	530 .	530 .
20. Corn — For Grain	531 .	531 .	531 .	531 .	531 .
21. Sorghum *(Excl. crosses)* — Planted and to be planted	570 .	570 .	570 .	570 .	570 .
22. Sorghum *(Excl. crosses)* — For Grain	571 .	571 .	571 .	571 .	571 .
23. Other Uses of Grains Planted — Use					
Acres abandoned, cut for hay, silage, etc. — Acres	.	.	.	.	.
24. Alfalfa and Alfalfa Mixtures (Cut and to be cut for hay)	653 .	653 .	653 .	653 .	653 .
25. Other Hay (Cut and to be cut)	654 .	654 .	654 .	654 .	654 .
26. Soybeans — Planted and to be planted	600 .	600 .	600 .	600 .	600 .
29. Rice — Planted and to be planted — Check Kind	☐ S ☐ M ☐ L	☐ S ☐ M ☐ L	☐ S ☐ M ☐ L	☐ S ☐ M ☐ L	☐ S ☐ M ☐ L
Rice — Acres	60_ .	60_ .	60_ .	60_ .	60_ .
30. Cotton Upland *(Exclude Am. Pima)* — Planted and to be planted	524 .	524 .	524 .	524 .	524 .
38. Other Crops — Acres planted or in use	— — — .	— — — .	— — — .	— — — .	— — — .
39a. Idle Cropland — Idle all during 1983	857 .	857 .	857 .	857 .	857 .

Figure 6. **Portion of a 1983 Enumerative Survey Questionnaire for Recording Planted Acreage of Individual Fields**

SECTION B — PARTNERSHIP OR JOINT OPERATION

Refer to face page to check box.

Is operation partnership or joint land operating arrangement?

☐ **YES** · *Continue.* ☐ **NO** · *Go to Section D.*

Earlier you indicated this operation was a partnership or joint arrangement.

Total Partners
921

(Including operator)

1. Do all partners share equally in day-to-day decisions?

   ☐ **YES** · *Consider the oldest as the operator.*

   ☐ **NO** · *The partner that makes most of the day-to-day decisions is the operator.*

   (Operator shown on face page must be the one making most day-to-day decisions or the oldest. Make corrections if necessary.)

2. Now I would like to *(verify/identify)* the other person(s) in this partnership or joint land operating arrangement.
   (Exclude Landlord-Tenant, cash rent or share crop arrangements.)

Name _____
(Last) (First) (Middle)

Address _____
(Route or Street)

_____ **Phone** (_____) _____
(City) (State) (Zip Code) (Area Code)

	LSF ID	CATTLE	HOGS	RICE
2		935	925	955

Name _____
(Last) (First) (Middle)

Address _____
(Route or Street)

_____ **Phone** (_____) _____
(City) (State) (Zip Code) (Area Code)

	LSF ID	CATTLE	HOGS	RICE
3		936	926	956

Name _____
(Last) (First) (Middle)

Address _____
(Route or Street)

_____ **Phone** (_____) _____
(City) (State) (Zip Code) (Area Code)

	LSF ID	CATTLE	HOGS	RICE
4		937	927	957

Figure 7. **Portion of a Questionnaire Used to Identify and Eliminate Duplication on a Survey List**

SRS questionnaires are prepared by experienced survey statisticians in Washington and are tested to determine effectiveness. Work on questionnaire design often begins during the previous year's survey. Improving the forms involves the combined assistance of the survey, commodity, and research statisticians, and of enumerators who do the actual field survey work. The designers strive to make questionnaires easy to follow, attractive to the eye, and convenient for recording and summarization.

All questions being asked must be approved by the Office of Management and Budget to ensure that the information requested meets the survey's objective with minimum burden on respondents.

Data Processing

Methodology for handling survey data changes rapidly. Nearly all reported survey data were hand-edited and tabulated by simple clerical procedures as recently as 1960. Virtually all survey data today are edited and summarized by computers. In addition, maintenance of list files and many other recordkeeping activities also depend on automatic data processing (ADP). The period of development of ADP coincides with the implementation of SRS probability surveys. Without ADP, summarization and analysis of data from some of the current sample designs would be impossible.

The original application of ADP was in the summarization of survey data. Computers were able to make the repeated calculations needed for summarization and computation of sampling errors much faster and more accurately than people. Although computer processing requires lead time for system development and programming, more detailed and complex summaries can be provided with little penalty in cost for processing time. This greater detail enables statisticians to thoroughly analyze current survey data and develop effective survey designs.

Editing of reported survey data (that is, searching and correcting the data for errors) by computer was implemented during the seventies. Computers are now used effectively for identifying errors in data from most SRS surveys. Most data checks can be done more accurately, consistently, and rapidly by a computerized edit routine than by a personal review. Consistency checks of various kinds are used, such as checking reported data items against predetermined limits or comparing one item with other related items reported on the same questionnaire. Computer-detected errors are often referred to as "critical" or "noncritical." Critical errors are those in which discrepancies in the data are certain and must be corrected. Noncritical errors are those in which the data item is suspected of being in error but, after further review or verification by the respondent, may be accepted. Most of the computer editing to date has been to identify or flag suspected errors in data. Only limited use has been made of computer imputation techniques which involve the supplying of missing data, or the correction of erroneous data, based on averages, relationships to other data, or data for a comparable reporting unit.

Development, use, and maintenance of lists for sampling and mailing purposes largely depend on modern ADP capabilities. Using a computer to identify and remove duplication from lists of names allows SRS to effectively use multiple sources when building a list sampling frame. Maintenance programs are used to keep the name and address information current as well as to maintain current control data needed to support sampling requirements. Sampling procedures support the need to select probability and nonprobability samples based on very general or extremely specific sampling criteria. Respondent burden can be monitored and limits on respondent burden can be established for nonprobability samples. Software enables computers to generate lists and labels used to mail survey questionnaires. Using the computer files, SRS can monitor survey respondents and generate special mailings, such as reminders to nonrespondents, and send survey results to respondents who have requested them.

Basic responsibilities for processing survey data lie within the SSO's. The first SRS computer systems and programming efforts were for national probability surveys processed at national headquarters because of the limited availability of large-scale computer facilities and technical resources in the SSO's. As equipment and technology became more widely available, the SSO's assumed much of the ADP responsibility for SRS surveys. Surveys still processed in the Washington office are primarily those that are national in scope and that require considerable technical input from the national staff. But, even for many of these surveys, the computer edit and data review responsibilities have been shifted to the SSO's.

Procedures were developed for standardizing SRS data processing activities to avoid duplication of effort and inconsistency between SSO's. A generalized systems approach to automation was established for handling most

of the data processing needs. Agencywide task forces were used to develop these systems. Some generalized systems in use by SRS are the list sampling frame system, generalized edit, generalized multiple-frame summary, enumerative summary, cross tabs, and charting systems. These systems are used by the SSO's and the national staff for most surveys, eliminating duplication of programming effort and providing more uniformity in ADP.

Another development in ADP of considerable significance to SRS is network processing. In 1973, selected SSO's and the national office were connected via a telecommunications network. As a result of this pilot project, all SSO's and the national headquarters were eventually connected to the same network. Each SSO has access to the network and central computer through terminals located in its office. Network processing has many advantages. Generalized systems need to be set up at only one location, but can be accessed and used by all. This minimizes duplication of systems and programming work and greatly facilitates data transmission to and from Washington, D.C.

The CRB uses an automated fruit and field crops data base (1939 to date) to assemble State estimates, create worksheets, and generate statistical tables for CRB releases. Current public access is via computer tape files. Future systems development will include adding the vegetable and grain stock estimates to the data base, and adding records for all years and items.

Computer Applications: Micro to Mammoth

SRS continues to adopt modern data processing methods and equipment. SSO's are now equipped with automated data entry equipment and are experimenting with computer-assisted telephone interviewing systems. Minicomputers are in use in several of the larger SSO's and in the lockup area in Washington, D.C., where they are used to process reports containing market-sensitive data in the lockup area.

SRS uses highly specialized computers for processing huge volumes of satellite data for research projects in remote sensing for crop estimation. In contrast, research is being carried out with very small hand-held computer devices for field data collection purposes.

Microcomputers are expected to have a significant impact on SRS functions. Coupling the tremendous computer power of microcomputers with office automation through local area networking (LAN) should make possible fully automated SSO's capable of independent ADP operations. At the same time, these SSO's will be nodes or end points of a fully automated SRS network. The West Virginia SSO has piloted SSO use of microcomputers with favorable results. LAN operation for SSO's is being researched and tested in Washington, D.C.

Chapter 4

Field Crops

Introduction

Estimates of harvested acreage and production for most major field crops originated in 1866; planted acreage estimates were initiated in 1919.

The statistical program for field crops encompasses forecasts made during the growing season and estimates made after harvest for major field crops at the State and national levels. In addition, county estimates are prepared for selected crops after the harvest is completed. State and national estimates are published in the monthly *Crop Production* report for planted acreage, harvested acreage, yield, and production. In addition, other SRS reports show estimates of grains and oilseeds stored on and off farms, percentage of crops marketed by months and value of production for the major field crops (table 1).

Changes in the Program

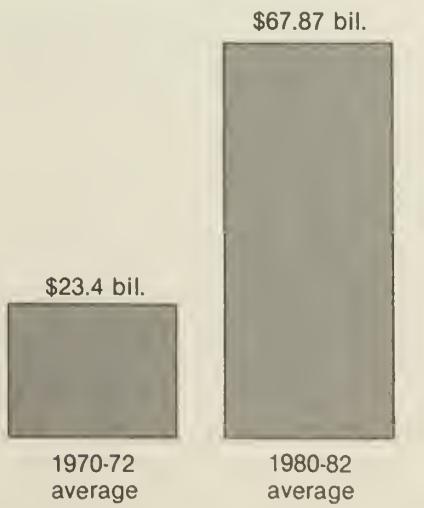
SRS periodically reviews the estimating program, bringing it up to date by addition or deletion of States or crops. For example, after the 5-year review for 1974-79, barley and rye estimates were dropped in a number of States because of small acreage. The frequency of corn yield and production estimates was increased in several Southeastern States where the crop is growing in importance.

In 1982, budget constraints forced the curtailment of reports for a number of field crops including white corn, popcorn, dry peas, seed crops, and producer-owned grain stocks. In addition, the July forecasts of yield and production of spring wheat, durum wheat, and corn were discontinued. The December forecast of winter wheat production for the following year was discontinued, but the acreage of winter wheat seeded for harvest the following year was not.

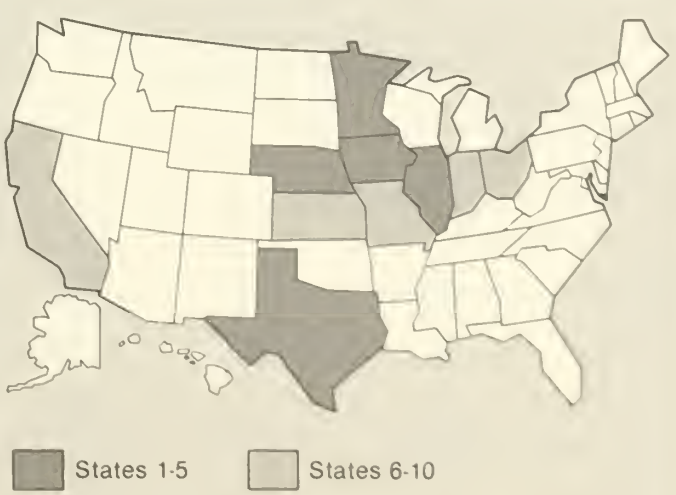
How Estimates Are Made

Estimates are based on sampling principles described in Chapter 2. Nonprobability mail surveys and area-frame and multiple-frame surveys are used for estimating production, stocks of grain, sales of crops by months,

Figure 8. **Value of Field Crop Production**



United States



Leading States, 1982

prices, and crop values. Objective yield samples, based on actual field measurements, counts, and weight for a subsample of the area frame, provide probability indications of yield per acre for corn, wheat, soybeans, potatoes, and cotton in major producing States. In addition, objective yield surveys provide an updated indication of acreage harvested for grain or cotton.

Multiple-frame surveys are used for rice and potato acreage, yield, and stocks stored on farms. Nonprobability mail surveys are still used for a number of crops because of their low cost. Followup telephone calls to nonrespondents supplement mail survey returns. As additional funds become available, mail surveys are being phased out and replaced with probability surveys.

Gathering data for SRS field-crop estimates is the responsibility of the SSO's. Their personnel mail questionnaires, provide training for interviewers, and work with field supervisors to ensure that interviewers complete their work on time and correctly. In addition, they review survey questionnares manually and computer-edit them. Edit messages are reviewed and corrections made before summarization. The summarized survey indications are plotted on time-series charts and analyzed. SSO's forward recommendations to Washington, D.C., where they are reviewed by the CRB.

Acreage Estimates

Acreage and yield are the two components used in forecasting and estimating production. These estimates are used extensively in planning, farm policy analysis, and program administration. Acreage reports help farmers plan and adjust their operations and make marketing decisions, serve as direct measures of land utilization, and indicate potential demand for various farm production supplies and labor.

SRS conducts three major acreage surveys. The prospective plantings survey in February provides early indications of what farmers intend to plant; the midyear acreage survey, conducted about June 1, is used to estimate spring-planted acreages and acreages for harvest; and the end-of-year acreage and production (A&P) survey is conducted after most of the field crops have been harvested.

Prospective Plantings

The cycle of acreage estimates for spring-seeded crops begins with the prospective plantings survey conducted about February 1 each year. (Past survey dates have included January 1, March 1, and April 1.) This is a nonprobability mail survey. Approximately 85,000 farmers receive questionnaires regarding spring planting plans; normally, over 60 percent complete and return them to SSO's.

Participating farmers are asked to report the acreages they expect to plant on the farm. From this information, SSO's compute indications on the percentage change from the previous year based on matched reports and a ratio of expected plantings to land or cropland.

Table 1—**Month of publication of field crop reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Crop Production	●	●	●	●	●	●	●	●	●	●	●	●
Production Summary	●											
June Acreage						●						
Prospective Plantings		●										
Small Grains Annual Summary												●
Grain Stocks	●			●		●			●	●		
Rice Stocks	●			●				●		●		
Peanut Stocks and Processing			●						●			
Hops Stocks			●						●			
Sugar Market Statistics		●			●			●			●	

The February prospective plantings estimates are based on interpretations of these survey indications for each State, utilizing time-series charts as described in Chapter 2. Because statistical reliability is greatest at the highest level of aggregation, the CRB first establishes regional and national estimates and the individual States are then set to add to the regional and national totals.

Differences between intended plantings and actual plantings can vary considerably, depending on changing circumstances including Government farm programs and changes in economic or weather conditions. Table 2 shows percentage changes from *Prospective Plantings* reports to final planted acreages for corn, cotton, and soybeans over the past 10 years.

Both probability enumerative and nonprobability mail surveys are conducted to establish midyear planted acreage estimates, but only nonprobability mail surveys are carried out for the prospective planting acreage estimates. The advantage of the added precision possible with the more costly probability survey is negligible for estimating prospective plantings because such precision would, in many cases, be nullified by the greater differences caused by changes in producers' plans between survey time and actual planting.

Midyear Acreages

Major nationwide enumerative and mail surveys are conducted about June 1 to establish estimates of spring-planted acreages and acreages for harvest. The results are released in the June *Acreage* report.

Acreage questionnaires are mailed to approximately 270,000 producers; about 40 percent of the questionnaires are returned and are used in computing the indications. Additional special questionnaires go to growers of certain crops (such as dry beans) to assure an adequate sample size for crops grown by relatively few producers. The same kinds of indications are computed from this mail survey as for the prospective plantings surveys. The June enumerative survey (JES) includes acreage data from a probability sample of segments which represent about 0.6 percent of the total U.S. land area. The primary indication from this survey is the direct expansion of reported acreages. An additional indication obtained from the JES includes a ratio expansion. This is a ratio of current year's data to the previous year's data for those area segments that were enumerated both years, multiplied by the previous year's JES direct expansion indication. In setting the estimates, time-series charts are used to evaluate the indications from both the mailed and enumerative surveys.

The size of the JES area-frame sample was established to obtain a relative standard error of 2 percent at the national level and about 6 percent at the State level for the direct expansions of major crop acreages. For corn, wheat, and soybeans, the most widely grown crops, the standard error is in the range of 1 to 2 percent at the national level and less than 6 percent for most major producing States. The standard errors for oats and cotton are near the 3-percent level for the Nation. The relative standard errors for minor crops produced in confined geographical areas exceed those for the major commodities.

Prior to the initiation of the enumerative survey in the midsixties, State estimates were established individually and added to obtain the national totals. Since then, the CRB has first set the regional and national estimates for major crops, using all the survey indications. This procedure utilizes the survey indications at their greatest level of precision. State estimates, set by the Board, equal the regional and national estimates.

The estimates of planted acreage published in the June *Acreage* report are normally not changed during the crop season. However, in some States, if planting is very incomplete when the survey is taken in June, additional information is collected in July from a subsample of those reporting in June. A ratio of change from the June survey is computed and summarized at the State and national levels. Revised estimates of planted acreage are made and published in the August *Crop Production* report when the July survey shows that revisions are needed.

Table 2—**Prospective planted acreage estimates as a percentage of final planted acreages, United States, 1973-82** [1]

Year	Corn	Upland cotton	Soybeans
		Percent	
1973	99	105	95
1974	101	108	105
1975	96	105	104
1976	98	97	98
1977	100	100	94
1978	98	97	98
1979	97	103	96
1980	98	102	102
1981	100	101	103
1982	103	111	96

[1]March 1, 1973-75; April 1, 1976-80; February 1, 1981-82.

Midyear estimates of harvested acreage are based on reported acres for harvest for the earliest harvested crops, such as the small grains. For the later harvested crops, such as corn and soybeans, initial estimates make normal allowances for abandonment and acres used for other purposes. Estimates of acreage for harvest are subject to monthly revision, although they usually remain unchanged through the season. Current monthly acreage indications are obtained from the objective yield measurement program for corn, cotton, wheat, and soybeans and for other crops from special surveys conducted when unusual weather or economic conditions could affect the acreage to be harvested.

Yearend Acreage Estimates

Estimates of acreage, yield, and production for barley, oats, rice, rye, and wheat are published in the *Small Grains Annual Summary* in December and again, along with all other field crops, in the *Crop Production Annual Summary* the following January.

The harvested acreage, yield, and production estimates are based on A&P mail surveys and final objective yield acreage data. The mail surveys are conducted after most of the field crops have been harvested. Many States conduct only one A&P survey for all crops. However, about one-third of the States, which harvest small grains very early, conduct two general A&P surveys, one between July and September for small grains and another in November or December for the later harvested crops. Supplemental surveys of known producers may be conducted for some crops not widely grown, or grown only in limited areas of a State.

Over 600,000 questionnaires are mailed for the A&P surveys. Farmers report acres planted, acres harvested, and production for each major crop utilization, such as grain or silage, and acres abandoned or used for other purposes.

The principal indications computed from the A&P survey for harvested acres are percentage change from the preceding year, based on matched reports; percentage of planted acres utilized for grain, silage (for some crops), or abandonment; and ratio of harvested acres to total land or cropland.

Time-series charts are used for interpreting the A&P mail survey indications. The A&P survey indications and final objective yield acreage survey data are the primary data sources considered in establishing the harvested acreage estimates. Consideration is also given to prior survey results and other available data. Supplemental information is obtained for certain crops from dealers and factories that contract acreage or production. Sugarbeet factories, for instance, provide useful data on planted and harvested acreage and production compiled from acreage they contract with farmers.

The CRB sets the harvested acreage estimates for major crops using the percentage change from preceding year based on matched reports and the percentage of planted acres utilized for grain, silage (for some crops), and abandoned. State recommendations are reviewed by CRB and adjusted to add to the national estimate. Changes in planted acres are a minimum since the indication available in June is considered most reliable.

Yield and Production Forecasts

Forecasts of expected yield and production are issued during the growing season and estimates are issued at season's end. Forecasts and estimates represent two distinct concepts in SRS. Forecasts relate to an expected future occurrence, such as crop yields expected prior to actual harvest of the crop. Estimates generally refer to an accomplished fact, such as crop yields after the crop is harvested.

The first forecasts of yield and production are made in May for winter wheat; in July for flue-cured tobacco, barley, oats, and rye; in August for spring and durum wheat and late-harvested crops such as corn, cotton, hay, peanuts, rice, sorghum, soybeans, sugarcane, and sugarbeets. Forecasts are adjusted to reflect changes that occur during growing and harvest seasons.

The monthly forecasts are based on indications obtained from both probability and nonprobability surveys. Monthly surveys of crop reporters provide subjective appraisals of local crop conditions and expected crop yields. General mail questionnaires are sent to about 55,000 crop reporters; normally, about one-half are received and summarized. Special questionnaires are sent to known producers of some crops which are grown in limited areas. In addition, enumerators make objective yield counts for approximately 1,900 corn samples, 1,600 cotton samples, 1,900 soybean samples, and 2,500 wheat samples.

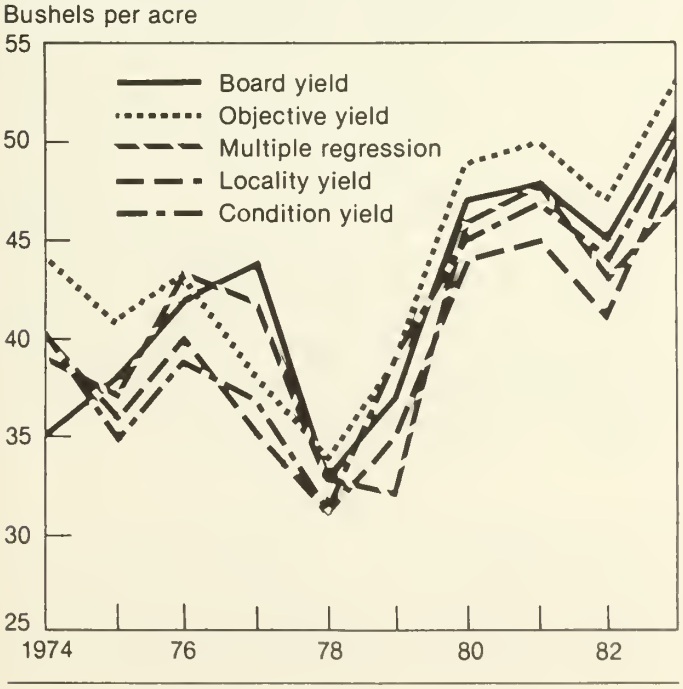
The CRB adopts corn, cotton, soybean, and wheat yield forecasts for major producing States by first establish-

ing regional levels, using indications from the probability objective yield surveys and nonprobability mail surveys. The individual State forecasts within the region are then set so they add to the regional levels. The crop forecasts for the smaller producing States are established individually, based on their respective survey indications.

State yields are adopted and multiplied by the current State acreages for harvest to obtain State production forecasts. The sum of State production forecasts is then divided by the sum of the State harvested acreages to derive the U.S. average yield.

A "limited forecast" program was initiated in 1971 for almost every crop. The States with very small production of a crop—those which individually account for less than 1 percent and collectively account for less than 5 percent of the U.S. production—are designated limited forecast States for the crop. In these States, the initial forecast of the season is carried forward unchanged in each succeeding monthly report. No new survey data are collected until the end of the season, at which time the individual crop estimates for all States are published in the *Crop Production Annual Summary*. The limited forecast program was adopted only after study indicated the program would not significantly affect the reliability of national forecasts.

Figure 9. **Time-Series Chart of May 1 Winter Wheat Yields**



Reported Condition

One of the original statistical activities of the Department was the reporting of condition of crops during the growing season. The concept of "normal condition" was first used around 1880 with 100 designated as normal condition. The concept is still used for early-season forecasts, before crop development has advanced enough for farmers to reasonably evaluate the output of plantings and report expected yields.

Crop reporters are instructed to "Report the condition of crops now, as compared with the normal growth and vitality you would expect at this time, if there had been no damage from unfavorable weather, insects, pests, etc. Let 100 percent represent a normal condition for field crops." The "normal" condition of a crop varies from one locality to another with differences in soil and climate. It also changes slowly in the same locality because of changes in varieties, cultural practices, and soil fertility.

Reported Yields

As the crops near maturity, crop reporters are asked to report the probable average yield in their localities. Averages of crop reporters' expectations of yield are plotted on time-series charts along with condition and objective yield indications, as shown in fig. 9.

The possibility of using weather data to forecast and estimate crop yields has been investigated on numerous occasions for most sections of the United States. The effects of weather and cultural factors are so complex that weather data alone do not provide a practical basis for estimating prospective crop yield per acre. Effectiveness of rainfall is usually reflected in the reported condition or expected yield of a crop at the time of the survey.

A forecast of prospective yield or production on a given date assumes that weather conditions and damage from insects, diseases, or other causes will be about normal (or the same as the average of previous years) during the remainder of the growing season. Forecasts based on current conditions and objective counts may be appraised accurately. However, if weather, disease, insects, or other conditions change, the final estimate may differ significantly from the earlier forecast.

Objective Yield Surveys

Objective yield surveys are conducted for cotton, corn, soybeans, and wheat in the major producing States. In

addition, pilot objective yield surveys are currently underway for rice, sorghum, and sunflowers. The sample objective yield survey fields are selected with probability proportional to planted acreage from the June enumerative and December eumerative survey area samples. Counts, vegetative measurements, fruit measurements, and weight of fruit are collected in season. The uniqueness of each crop requires the use of different plot size and measurement of different plant characteristics for efficient estimation. Procedures for the four operational surveys are briefly described here.

Corn

Corn objective yield surveys are conducted monthly from August through November for 10 major producing States. There are about 1,900 samples in the survey. Two plots, each containing 2 rows 15 feet in length, are laid out randomly from a selected starting point in each field. Two components, number of ears and weight per ear, are used to forecast biological yield. Early in the season, immaturity of ears or lack of ear development precludes direct measurement of ears and sometimes even an ear count. Vegetative characteristics and historic data provide the basis for some early-season forecasts. Later, specific stages of kernel development are used to determine the forecasting models for both number of ears and weight of ears. The stages of development are: pre-blister, blister, milk, dough, dent, and mature. The forecast models are similar to the following:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \ldots.$$

Where:

Y = number of ears or weight per ear,

a,b = parameters derived from observed relationships in previous years, and

X = independent variables from current field counts or laboratory measurements.

The data for sample plots are then expanded to an acre basis. Two regression models (developed on an individual State basis and referred to as Model I and Model II) are used to forecast number of ears and ear weight. The parameters used in each model change as the crop develops. Model I uses stalk count to forecast final number of ears for sample plots in the pre-blister, blister, and milk maturity categories. The actual ear count is used to forecast the number of ears for sample plots in the dough, dent, and mature maturity categories. Before ears are formed and during the pre-blister maturity category, an historical 3-year average is used to forecast ear weight. From blister through dent, the average kernel row length of five ears is used in the regression model. Finally, at maturity, the ears from one row of each sampling unit are husked and weighed.

Model II forecasts the number of ears for the pre-blister, blister, and milk categories using the sample ratio of stalks with ears or ear shoots to total stalks. For the dough, dent, and mature categories, an actual count of ears is used. To forecast ear weight, Model II uses the average length of the ear over husk. When the plot is mature, weight of harvested grain is also used as the forecast (as for Model I). Two of the harvested ears are selected at random to estimate moisture content and shelling percentages. The predictions of number of ears and of ear weights are combined to derive a composite estimate of ears and ear weights from the sample. The weights used to combine the predictions depend on the precision expected for each of the two models judged by correlation of the indicator with final data.

After harvest, a subsample of plots is selected for harvesting loss gleanings. Estimates of these losses are computed and subtracted from the biological (gross) yield to determine net yield per acre.

Cotton

About 1,600 cotton samples are selected from the JES in six major States. Two sample plots, each containing two 10-foot row sections, are located randomly from a selected starting point in each field. A 3-foot tag section is located beyond row one of unit one and a 3-foot count section is beyond row one of unit two. At the time of each sample visit, detailed counts of squares, blooms, bolls, and open bolls are made in the 3-foot unit. Specific colored tags are attached to fruit in specific stages of development in the tag section during each month's visit. A count of tags remaining on the surviving fruit at the time of succeeding visits is recorded. These counts provide data needed to determine rate of fruit development and the survival ratio of fruit as the plant moves toward maturity. As bolls open, the cotton is picked and weighed to determine average boll weight.

The gross yield forecast for each sample is derived by multiplying the historical average lint/seed ratio by the expected boll weight times the number of large bolls. The expected number of large bolls is estimated by using both a survival model and a multiple-regression model. Both use the following formula:

$$Y = a + bx_1 + cx_2 + dx_3$$

Where:

Y = forecast number of large bolls;

x_1 = number of burrs, large open bolls, and large unopened bolls;

x_2 = number of small bolls and blooms;

x_3 = number of squares; and

a,b,c,d = parameters derived from observed relationships of previous years.

For the survival model, the coefficients a, b, c, and d are developed from historical fruit survival rates for various maturity categories of squares, blooms, small bolls, and large bolls. Three of the coefficients (b, c, d) are average survival rates and a is the average number of large bolls expected from fruit not set. These coefficients vary depending on the maturity categories for fields. The coefficients for the multiple-regression model are determined by least-squares procedures. The forecasts from the two models are weighted by the reciprocal of their forecast errors.

One model is used to forecast weight per boll. Early in the season, the historical average is used until 20 percent of the projected number of large bolls have been picked. Then, the following forecast model is used:

$$Y = W_1(a + bx_1)$$

Where:

Y = forecast boll weight,

W_1 = observed boll weight,

x_1 = ratio of number picked to number of large bolls expected, and

a,b = coefficients.

The forecast of harvest loss prior to completion of harvest is based on historical averages. Actual harvesting loss is determined immediately following harvest, based on gleanings of sample units.

Soybeans

Soybean objective yield surveys are conducted in 15 States. About 1,900 samples are selected for observation. In the six major States (Illinois, Indiana, Iowa, Minnesota, Missouri, and Ohio), the survey is conducted from August through November. The remaining States conduct the survey from September through November.

Two sampling units are laid out randomly from a selected starting point at the edge of the field. The units include two rows—each having a 6-inch "count unit" and a 36-inch "observation unit." Number of plants and maturity are coded for the observation portion of the sample unit. When the pods of a sample unit are brown and nearly or actually mature, all pods from row one of the unit are stripped and sent to a regional laboratory for weighing and analysis. Data collected from the 6-inch count units include number of plants, number of main stem nodes, number of lateral branches, total fruit (blooms, dried flowers, and pods) on the mainstem and lateral branches, and pods with beans.

To arrive at yield, forecasts are made of number of plants, number of pods per plant and weight of beans per pod; linear and curvilinear regression equations are used to forecast the number of plants. A curvilinear regression equation is usually used for samples in immature categories. As plants in the units approach maturity, a linear regression is used since the number of plants stabilize and the survival rate is quite high. The number of pods per plant is forecast using multiple-regression equations. The regression equations utilize different independent variables at various maturity categories. The forecast equations for soybeans are very sensitive to changes in maturity. Because of this, there are 11 maturity categories. Variables used in the multiple-regression equations for maturity categories 0 through 9 are shown in table 3.

The third component of yield is the forecast of weight of beans per pod. Research has indicated that predicting the weight of beans is very difficult because there is no fruit to analyze in the laboratory until the crop approaches maturity. Also, predicting the weight of beans is quite susceptible to sampling error. Therefore, a 5-year running average weight of beans per pod is used for all maturity categories, except the mature category which uses actual sample weight per pod.

A subsample of the objective yield sample fields is selected for postharvest gleanings. The units for gleaning are located close to the original sampling units. The postharvest unit is gleaned thoroughly. Beans are sent to

regional laboratories where they are weighed and tested for moisture. The gleaning samples are then expanded to obtain a State harvesting loss. This loss is subtracted from the biological yield to arrive at a net yield per harvested acre.

Table 3—**Variables used in multiple-regression equations to forecast number of soybean pods per plant**

Variable	Maturity categories[1]									
	0	1	2	3	4	5	6	7	8	9
Plants per unit area	●	●	●	●	●	●	●	●		
Mainstem nodes per plant		●	●	●						
Total fruit (blooms and pods per plant)			●	●	●	●				
Lateral branches with fruit per plant				●	●	●	●	●	●	●
Pods with beans per plant							●	●	●	●

[1]Actual weight of harvested beans is used for maturity category 10.

Wheat

Wheat objective yield surveys are conducted for the winter, spring, and durum wheat crops. Winter wheat surveys are conducted in 14 States using about 1,900 samples from May through September. Spring and durum wheat objective yield surveys are conducted August through October, using about 200 durum wheat samples and 400 other spring wheat samples. Five States conduct spring wheat surveys and three conduct durum wheat surveys.

Two plots are laid out randomly from a selected starting point in each field. In drilled fields, each plot contains three rows with a count area and two clip areas as shown in fig. 10.

The forecasting procedures use, in general, two models for predicting head weight and one model for predicting number of heads. Early in the season, vegetative growth and historical averages are used in regression to predict both the number of heads and head weight. As the crop matures, actual counts and weights of heads are used. The forecast models for number of heads and weight per head are similar to the following:

$$Y = a + bX_i$$

Where:

Y = number of heads or weight per head,

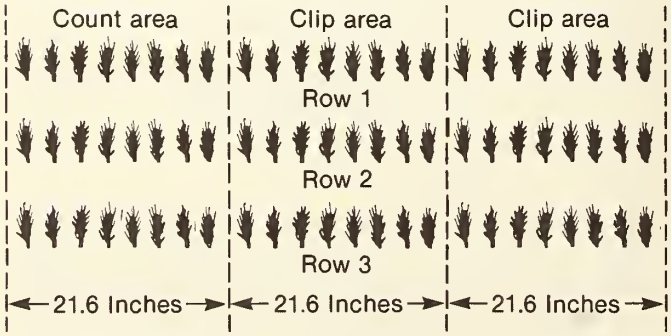
a,b = parameters derived from observed relationships of previous years, and

X_i = independent variables from current field counts (such as number of stalks or number of heads) and laboratory measurements.

Yield and weight per head from the sample plots are then adjusted to a per-acre basis based on size of plot. The particular regression model used depends to a great extent on the maturity of the crop. Maturity categories used for wheat are pre-flag, flag or early boot stage, late boot or flower, milk, soft dough, hard dough, and ripe. In the pre-flag category, a count of number of stalks is used as the variable in the regression equation to estimate number of heads. A count of emerged heads plus heads in late boot is used in the late boot through the soft dough categories. An actual count of heads is used for the hard dough and ripe categories. Head weight is predicted by two regression models, Model I and Model II.

For Model I, the historical average is used for the pre-flag and flag or early boot maturity categories. For the late boot or flower stage, a regression equation predicts final head weight from fertile spikelets. Weight per head in the milk and dough maturity categories is predicted by clip unit grains per head. Actual laboratory weight is used when wheat reaches the hard dough and ripe maturity categories. The multiple correlation coefficient provides a measure of the relative effectiveness of the models and is used to weight the models together for a

Figure 10. **Wheat Objective Yield Plot, Drilled Field**



composite best estimate of head weight. Postharvest gleanings are made from a subsample of plots located near the original sample plots. The area is gleaned thoroughly. The weight of the gleaned grain is expanded to a State harvest loss figure. This harvest loss is subtracted from the gross yield for a net yield per acre.

Model II is not used when wheat is in the pre-flag or early boot maturity categories. An historical average head weight is used to estimate head weight when the sample reaches the late boot or flower maturity categories. Weight per head is used in a regression equation linking green weight per head to final weight for the milk and dough maturity categories. Actual average weight from the sample is used for the hard dough and ripe categories.

Reliability of Production Forecasts

To assist users in evaluating the reliability of production forecasts, root mean square error (RMSE) is published in *Crop Production*. This statistical measure, based on past performance, is computed by expressing the deviations between the production forecasts and the final estimates as a percentage of the final estimates and averaging the squared percentage deviations for a 20-year period. The square root of this average is the RMSE. Probability statements can be made concerning expected differences in the current forecasts relative to the final end-of-season estimates, assuming that factors affecting this year's forecast are not different from those influencing recent years.

For example, suppose the RMSE for the October 1 corn for grain production forecast is 3.8 percent and that production was estimated at 8,314,938,000 bushels. This means chances are 2 out of 3 that the current production forecast will not be above or below the final estimate by more than 3.8 percent or 316 million bushels. Chances are 9 out of 10 (90-percent confidence level) that the difference will not exceed 6.6 percent or approximately 550 million bushels. Also, the monthly *Crop Production* report shows the range of differences between forecast and final estimates during the past 10 years for selected crops, and the number of times the forecasts were above or below the final estimates. Table 4 shows a typical reliability table from the report.

Table 4—**Reliability of October 1 crop production forecasts**

Crop	Unit	Root mean square error			10-year record of differences between forecast and final estimate				
			90-percent confidence level		Quantity			Number of years	
				Quantity	Average	Smallest	Largest	Below final	Above final
		Pct.	*Pct.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*No.*	*No.*
Feed grains[1]	M.T.	3.1	5.4	14	7	1	14	8	2
Corn for grain	Bu.	3.8	6.6	549	224	16	548	8	2
Sorghum for grain[2]	Bu.	4.6	8.0	66	26	3	76	4	6
All wheat[2]	Bu.	1.3	2.2	62	16	1	44	6	4
Durum[2]	Bu.	4.5	7.8	12	3	1	8	6	4
Other[2]	Bu.								
Spring[2]	Bu.	3.1	5.4	30	6	0	13	7	3
Rice	Cwt.	2.7	4.7	7	3	0	7	6	4
Soybeans for beans	Bu.	3.4	5.9	136	64	35	120	6	4
Cotton[3]	Bale	5.4	9.3	1,060	454	17	1,273	5	5
Fall potatoes	Cwt.	2.5	4.3	13	6	1	13	9	1

[1]Corn for grain, sorghum for grain, oats, and barley.
[2]Board estimate.
[3]Quantity is in thousands of bales.

Yearend Yield and Production Estimates

Estimates of yield and production for small grains are published in the *Small Grains Annual Summary* in December and again, along with all other field crops, in the *Crop Production Annual Summary* the following January.

The yield estimates are based on the end-of-season A&P and final objective yield surveys, and indications from the last monthly farm report survey of the growing season. The A&P survey is conducted after most of the field crops have been harvested. Separate surveys of known producers are conducted for some crops not widely grown, to supplement the data collected on the general surveys covering several crops.

Around 250,000 questionnaires are tabulated for the A&P surveys. Yield indications are derived by dividing the reported production by the reported acres harvested. The final yields obtained from the objective yield surveys of corn, cotton, soybeans, and wheat are based on production harvested from the sample plots, less harvesting losses (which are determined after farmer harvest of the crop by gleaning other nearby sample plots newly selected for that purpose).

Time-series charts are used for interpreting the A&P survey indications, final objective yield results, and farm report indications. Supplemental information is obtained for certain crops from dealers and factories that contract acreage or production.

Grain and Oilseed Stocks

Quarterly reports indicating first-of-month stocks of feed grains, food grains, and oilseeds on farms and in commercial storage off farms are an important part of the crop estimating program. The timing for first-of-month stock estimates is shown by crop in table 5.

Onfarm Stocks

The basic data for quarterly estimates of farm stocks are obtained from multiple-frame probability surveys in 22 major grain-producing States. In the remaining States, a nonprobability mail survey is used to estimate the farm stocks.

The multiple-frame probability survey (discussed in Chapter 2) consists of a stratified systematic sample selected from the list sampling frame maintained by each SSO. In addition, farmers listed in the JES but not found on the list frame are surveyed quarterly and the sample expanded to represent the incompleteness of the list frame.

Indicators used for farm stocks are the direct expansion, ratio of stocks to the farmer's production of grain, and the ratio of this quarter's stocks to last quarter's stocks. Grain production is obtained at the beginning of the marketing year for each farmer in the sample. Direct expansions are obtained by multiplying survey data by the reciprocal of the sampling fraction for each stratum and summing the strata. Stocks of grain on reporting farms are divided by the production of grain on these farms to obtain a ratio of stocks to production. The ratio of this quarter's stocks to last quarter's stocks is based on matching reports for identical farms.

In the remaining States, a nonprobability mail survey is used to collect the data. Telephone followups are often used to ensure an adequate number of returns from farmers. Indicators used are ratio to production, ratio to previous quarter, and, in a few States, ratio to previous year's stocks.

The CRB reviews recommendations from the SSO's. A regional estimate is first established by CRB for the speculative States combined. Individual State estimates are then set that will sum, within rounding limits, to the regional level. Estimates are established on a State-by-State basis for all remaining States.

Off-Farm Stocks

Indications of stocks of grain and oilseed crops in commercial off-farm storages are obtained from quarterly surveys. Lists of all known commercial grain storage facilities (about 14,000) and their capacities are maintained in each SSO. The lists are divided into groups of similar plants, such as mills and elevators, terminals, oilseed processors, and other storages; each group is stratified by size. Estimates are made for each group and totaled for the estimate of stocks in all off-farm storages. A complete enumeration is made of the largest units; smaller facilities are sampled. About 85 percent of the total off-farm grain and oilseed storage capacity is included in the sample survey returns. All rice storage facilities are enumerated.

Separate tabulations and expansions are made of the reports for each strata of plants in the State. Stock estimates for the sampled portion of the grain storage facilities are based on two indications: a ratio-to-capacity

expansion and a regression indication for average stocks per plant. For the first indication, the ratio of stocks to the capacity of reporting firms is applied to the total universe capacity. The regression indication adjusts average stocks per plant for any consistent bias in the sample. Average stocks per plant would be a good indication of stocks when the average plant capacity is the same for the sample and the universe. However, if the average capacity of the reporting plants is either smaller or larger than for all plants, this indication (without adjustment) would probably be biased.

The expansion based on ratio to capacity is a reliable indication of grain stocks when the ratio of stocks to plant capacity tends to be the same for all plants regardless of size and response rate. It is reasonable to assume that these ratios are approximately equal when stocks are large and virtually all plants are nearly filled to capacity.

The regression method provides a more reasonable adjustment for estimating differences between the reporting firms and all firms in the universe. This method will give the same result as the ratio estimate if the relation between stocks and capacity of reporting firms and all firms is a simple proportional line. However, if this is not true, the regression adjusts for the difference in average size of plant. This adjustment is made by the equation:

$$Y'_s = Y_s - b(X_s - X)$$

Where:

Y'_s = adjusted average stocks for plants in the sample,

Y_s = observed average stocks for plants in the sample,

b = regression coefficient of stocks on plant capacity,

X_s = observed average capacity for plants in the sample, and

X = average capacity of all plants in the State.

The regression coefficient b is the only quantity whose numerical value is unknown. To minimize the arithmetic required, the approximate estimate of b is computed as follows: The sample plants are separated into two groups on the basis of size (capacity). The average capacity and stocks per plant are computed separately for each group of plants. The ratio of the differences of these averages is an estimate of b.

Both the regression and the ratio-to-capacity methods are based on the assumption that the relation of stocks to capacity for plants in each size group is the same for reporting and nonreporting plants. To the extent that this assumption is not valid, neither method completely adjusts for the selectivity in the returns. The off-farm stocks estimates are established State by State; the U.S. total is the sum of State data. Individual State off-farm stocks are not published separately for those States in which a few firms hold a high proportion of the stocks and publication could divulge the holdings of an individual firm. Stocks of the crop for all States falling in this category are combined and shown in an "unallocated" total for the United States.

Monthly Sales

Monthly estimates of the percentage of grain marketed are published for major crops in the December *Crop Production* report; cotton marketing data are released in the December and May *Crop Production* reports.

Surveys of grain purchases by mills, elevators, and dealers who buy direct from farmers are made each month. Quantities purchased are summarized by months and converted to percentages of total annual receipts. These percentages are evaluated on time-series charts maintained for each commodity, showing seasonal marketing patterns for several years.

Tabulations of dealer purchases are generally more reliable than monthly sales reported by farmers, since the dealer universe is relatively small and surveys cover a larger proportion of the crop sold. However, for hay and some other crops, monthly sales information obtained from farmers is the main source of data available.

Value of Sales and Production

The value of sales of each crop is the estimated quantity sold multiplied by the season-average price per unit of measure. Similarly, value of production is calculated by multiplying total production by the season-average price received for the portion sold. For most crops, the season-average price is derived by weighting monthly prices by the quantities sold each month of the crop

Table 5—**Program of feed-grain, food-grain, and oilseed estimates**

Feed grains	Corn	Barley	Oats	Sorghum
States estimating	47	29	36	23
Full forecasts	24	17	21	11
Limited forecasts	23	12	15	12
Type of estimate				
January	E,V,S	V,S	V,S	E,V,S
February	I	I	I	I
March				
April	S	S	S	S
May				
June	P,H,S	P,H,S	P,H,S	P,H,S
July		H,F	H,F	
August	H,F	H,F	H,F	H,F
September	H,F	H,F	H,F	H,F
October	H,F,S	S	S	H,F,S
November	H,F			H,F
December	M	E,M	E,M	M

Food grains	Winter wheat	Spring wheat	Durum wheat	Rice	Rye
States estimating	41	12	6	6	26
Full forecasts	26	6	4	6	18
Limited forecasts	15	6	2	0	8
Type of estimate					
January	S	S	S	S	
February		I	I	I	
March					
April	S	S	S	S	
May					
June	P,H,F,S	P,H,S	P,H,S	P,H	P,H,S
July	H,F				H,F
August	H,F	H,F	H,F	H,F,S	H,F
September	H,F	H,F	H,F	H,F	
October	S	H,F,S	H,F,S	H,F,S	H,F
November					
December	I,E,M	E,M	E,M	E,M	I,E,M

Oilseeds	Soybeans	Flaxseed	Sun-flowers	Peanuts	Cotton-seed[1]
States estimating	29	3	4	9	17
Full forecasts	22	3	4	8	17
Limited forecasts	7	0	0	1	0
Type of estimate					
January	S,E		E,S	E,S[2],E	
February	I	I	I	I	
March					
April	S		S		
May					E
June	P,H,S	P,H,S	P,H,S	P,H	
July				S[3]	
August	H,F	H,F		H,F	F
September	H,F,S	H,F		H,F	F
October	H,F		S	H,F	F
November	H,F			H,F	F
December	M	M,E		M	F

[1]Cottonseed production forecasts at U.S. level only August through December; by States and for the United States in the January *Annual* and May *Crop Production* reports. [2]Stocks as of end of January. Published in March. [3]Stocks as end of July. Published in September.

Key: P = Planted acres
H = Harvested acres
F = Forecast yield and production
I = Planting intentions
E = End-of-year estimates of planted acreage, utilization, yield, production
V = Season-average price and value of production
S = Stocks
M = Percentage of crop marketed by months

marketing season. For price-support crops, an allowance is made for unredeemed Commodity Credit Corporation (CCC) loan and purchase agreement deliveries valued at the average loan rate.

Food-Grain, Feed-Grain, and Oilseed Estimates

Field crops are divided into four groups—food grains, feed grains, oilseeds, and special crops. The estimating programs for the first three groups are similar and have been covered in earlier sections of this chapter. Table 5 indicates full and limited estimating States and type of estimates published by month for food grains, feed grains, and oilseeds.

Special Crops

Special crops include those which are not part of the food-grain, feed-grain, or oilseed group or those food-grain, feed-grain, or oilseed crops for which survey procedures, check data or scope of estimates warrant further explanation.

Cotton

Cotton production is concentrated on the High Plains of Texas and Oklahoma, in the Delta of the Mississippi River, and in the irrigated valleys of New Mexico, Arizona, and California. Separate estimates are made for upland (short staple) and American Pima (extra-long staple) cotton. Upland accounts for 99 percent of all cotton produced. American Pima is grown primarily in Texas, New Mexico, and Arizona.

Production forecasts for 14 major States begin August 1 and continue monthly through January. A production forecast is made for August and carried forward monthly until the January final estimate for three limited-forecast States which account for less than 1 percent of the U.S. crop.

Three independent sources of data are used in making the monthly production forecasts: objective yield surveys, monthly general mail surveys, and Bureau of the Census ginners' reports. Monthly general surveys and objective yield surveys were discussed earlier in this chapter.

The ginners' indications provided to SRS by the Bureau of the Census are used in months when ginners can accurately forecast the number of additional bales expected to be ginned. In recent years, with the practice of later ginnings in most States, this indication is used primarily for the November, December, and January forecasts.

The average bale weight reported by ginners is also used in forecasting cotton production in 480-pound net weight bales. A cross-State ginning factor (cotton grown in one State and ginned in another) is also used to adjust reported indications of cotton ginned.

To summarize, the components of the ginners' indicated expansion are:

$$Y = \left[\frac{AB}{480}C\right] \div D$$

Where:

Y = indicated production in 480-pound net weight bales,

A = average net weight per running bale,

B = cross-State ginning percentage,

C = estimated bales ginned to date, and

D = board-estimated percentage ginned to date.

Monthly forecasts are always based on appraisals of two to five indications of production. R^2 values computed from regression analysis are a valuable tool for deciding the best indications for different months of the year.

Rice

Six States estimate rice. Each is a full forecasting State. The acreage and yield and stock surveys for rice are all based on multiple-frame sampling (see Chapter 2). A comprehensive effort is made in the rice-producing States to develop a complete list frame of rice producers. The small incompleteness of the list frame is measured by rice growers reporting on the June enumerative survey who are not present on the list frame. Data from these producers, or the nonoverlap portion of the survey, are expanded to a State total and added to list frame expansions for a State estimate of total acreage, yield, or stocks.

Tobacco

Variations in soil types, topography, climate, curing methods, and other factors make possible the produc-

tion of 7 principal classes and 21 types of tobacco. Burley is the most widely grown type but flue-cured accounts for more than one-half of the U.S. production. Tobacco statistics have been available by States since 1866, and estimates by classes and types, since 1919.

State estimates are made for tobacco acreage, yield, production, price, and value by major classes and types. Production forecasts are made in July for all types of flue-cured tobacco combined and in August for each class and type. Production forecasts are made September through November for all classes and types combined. An additional forecast is made in December for burley (Type 31). The *Crop Production Annual Summary* published in January carries the preceding year's production estimates for all classes and types of tobacco. Estimates for all types are subject to revision in May except Southern Maryland Type 32, which is revised the following August.

Production forecasts are based on condition and probable yield indications obtained from monthly questionnaires mailed to volunteer crop reporters. Marketing data from ASCS and AMS are used in establishing production estimates in January and during revisions.

Burley indications obtained by mail surveys in Kentucky are supplemented by objective yield surveys of sample fields identified in the JES. In these sample fields, randomly selected plots are marked for plant and leaf counts and leaf measurements, and weights. After curing, the leaves are stripped and weighed to obtain a final objective yield indication.

The marketing season for tobacco begins in July with the flue-cured crops and ends in June of the following year with Southern Maryland Type 32.

Sugar

Sugarbeet estimates of planted and harvested acres, yield, production, prices, and value are made for individual States. National estimates are also made for beets sliced, sugar, molasses, and three types of beet pulp.

Sugarbeet statistical surveys follow the usual pattern of field crops from planting intentions through the growing season. Planted acreage is first published in the *Prospective Plantings* report and harvested acreage is first published in June *Acreage*. Yield and production forecasts are shown in the August through November *Crop Production* reports. Preliminary annual estimates for crop acreage, yield, beet production, and sugar production are published in the *Crop Production Annual Summary*. Revisions of these items plus the quantity of beets sliced and production of molasses and beet pulp are published in the June *Crop Production* report. Final revisions are published in the *Crop Production Annual Summary* the following year.

Sugarcane statistics of harvested acreage, yield, cane production, price, value, and sugar and molasses production are made for individual States. No estimates are made of planted acreage. The usual growing practice is to harvest several crops from a single planting. After the cane is cut, the crop grows again from the established root system. In Hawaii, the crop is usually allowed to grow for 2 years between harvests.

The sugarcane statistics program begins with the June *Acreage* report of acreage for harvest for sugar and seed. Growing-season yield and production forecasts are shown in the August through November *Crop Production* reports. These estimates are for combined sugar and seed uses. Separate estimates for the two are first made at the end of the season. Preliminary annual estimates are published in the *Crop Production Annual Summary*, revisions are shown in the June *Crop Production* report, and final estimates are published in January the following year in the *Crop Production Annual Summary*.

Some of the survey data are collected from sugarbeet and sugarcane growers by use of mail questionnaires, telephone, and personal interviews. In addition, considerable data are obtained from sugar companies that contract acreage and process the crop, and from planters' or processors' associations. Sugar company data are obtained by the SSO's on special questionnaires from home offices of the firms. These completed questionnaires are the primary basis for acreage estimates and yearend production totals. They also provide the basis for sugar, molasses, and pulp estimates.

Data on raw and refined sugar production and marketings are collected quarterly and accumulated on a calendar-year-to-date basis. Questionnaires are sent to all firms producing raw sugar from sugarcane and sugarbeets and to all refiners about 1 month before each quarterly report is published. Data are obtained from all large firms and most of the small ones. Results are reported in the quarterly *Sugar Market Statistics*. All data are expressed on the common basis of short tons, raw value.

Mint for Oil

Estimates of acreage and production for peppermint and spearmint combined began in 1929, with separate estimates established in 1935. Peppermint accounts for about three-fourths of the total mint acreage. Most of the world's supply of peppermint and spearmint oils comes from Indiana, Michigan, Wisconsin, Idaho, Oregon, and Washington.

Acreage, yield, and production estimates are published once yearly in the *Crop Production Annual Summary*. These estimates are subject to revision the following December.

Indications for preparing estimates are obtained from mail surveys or personal enumeration of mint growers. Buyers, brokers, associations, and other key contacts provide valuable check data for estimating mint acreage and production.

Hops

Estimates of hops acreage harvested, yield, production, and value began in 1915. Data on stocks were first collected in 1937 and became a part of the regular estimating program in 1947.

Forecasts of harvested acreage, yield, and production are published in *Crop Production* from August through October. End-of-season estimates of harvested acreage, yield, and production are shown in the *Crop Production Annual Summary*. The hops stocks held by brewers, dealers, and growers are reported in March and September *Hop Stocks* reports.

Estimating procedures for hops production are similar to those used for other field crops, incorporating harvested acreage, condition, and yield data. California, Idaho, Oregon, and Washington SSO's maintain hops producer lists, and mail questionnaires to a sample of growers monthly during the growing season and at the end of the season to obtain indications of harvested acreage, condition, and yield. Close liaison is maintained with the Hops Administrative Committee and buyers and dealers. These sources and inspection records provide the basis for determining final production.

Hop stocks estimates are based on a total enumeration of all growers, dealers, and brewers. SSO's gather information from growers while the SRS Estimates Division gathers the data from dealers and brewers. The data are gathered and published on a dry-hops-equivalent basis even though the hops may be in pellet or extract form.

Coffee and Taro

Acreage harvested, yield, production, price, and value statistics are published for Hawaiian coffee and taro. No forecasts are issued for these crops. Preliminary end-of-season estimates are published in the *Crop Production Annual Summary*. Revisions for taro are published in the May *Crop Production* report and for coffee in the September report.

Coffee is shown as a dual crop-year since harvest normally begins in September and extends into the early part of the following calendar year. Therefore, the 1982-83 crop production is included in 1982 statistics. Data collected from all growers, processors, or handlers provide the basis for coffee and taro estimates.

Dry Edible Beans

The program of dry edible bean estimates follows the pattern of other field crops, beginning with the *Prospective Plantings* report. In addition to the usual estimates provided for field crops, estimates of production by classes are included in the December *Crop Production* report and in the *Crop Production Annual Summary* issued in January. The program for dry beans includes 13 States for field beans but excludes garden seed production.

Information on acreage planted obtained in general acreage surveys and the JES or other probability surveys is supplemented by dealer surveys to determine the amount of seed distributed to growers.

The Michigan SSO conducts a multiple-frame survey in July to determine acreage of dry beans. The list frame is a compiled list of growers. The area frame covers a sample of about 200 land segments (double the size of the JES) in 16 major producing counties. The area frame is stratified based on the propensity to grow dry beans. The augmented area-frame survey helps identify acreage of casual growers (inners and outers) who use dry beans as a late-season substitute crop. The timing is better than the earlier June enumerative and acreage surveys, where a higher incidence of reporting "intentions" occurs.

The initial forecast of harvested acreage, yield, and production is made on August 1 for all States. Monthly forecasts follow through November for the 10 major

States, while the August 1 forecast is carried forward monthly for 3 minor producing States.

The monthly yield and production forecasts are based on reported local condition and probable yields from the general mail survey and special surveys of known growers. Many States use the grower surveys and dealer opinions to supplement the monthly general mail surveys.

The final end-of-season estimates of acreage, yield, and production by class are based on surveys of growers and useful production check data by commercial classes obtained from bean dealers and industry groups.

Peanuts

Peanuts are included with the oilseed crops. Basic methods for estimating acreage, yield, and production are similar to those for other field crops. Prior to 1982, the crop was grown under an alloted acreage and poundage program whereby only growers with allotments could produce peanuts. In 1982, the program was changed to a two-tier poundage quota system allowing any person, with or without an allotment, to grow peanuts. Supplemental check data play an important part in the peanut estimating program. ASCS obtains certified acres and final marketings from administration of the peanut program; AMS provides complete marketing inspection data.

The March *Peanut Stocks and Processing* report shows stocks of peanuts and peanut products as of January 31 and utilization for August 1 through January 31. The September report shows stocks as of July 31 and utilization for February through July. The universe for this report includes about 90 shellers and crushers, 300 commercial processors, and 200 warehouses. Principal items covered in these reports are inventories of farmers' stocks, roasting stocks, and shelled peanuts; disappearance; millings; production of edible peanut products; crushings; and production of oil and meal and peanuts used in the manufacture of primary edible products.

Chapter 5

Vegetables, Potatoes, Sweetpotatoes, and Mushrooms

Introduction

Estimates of commercial vegetables began in 1914 with onions and cabbage. By 1916, acreage, yield, and production estimates were made for most commercial fresh market vegetables. These fresh market estimates were of commercial production mainly for shipment to distant markets. Estimates of processing vegetables also began in 1916.

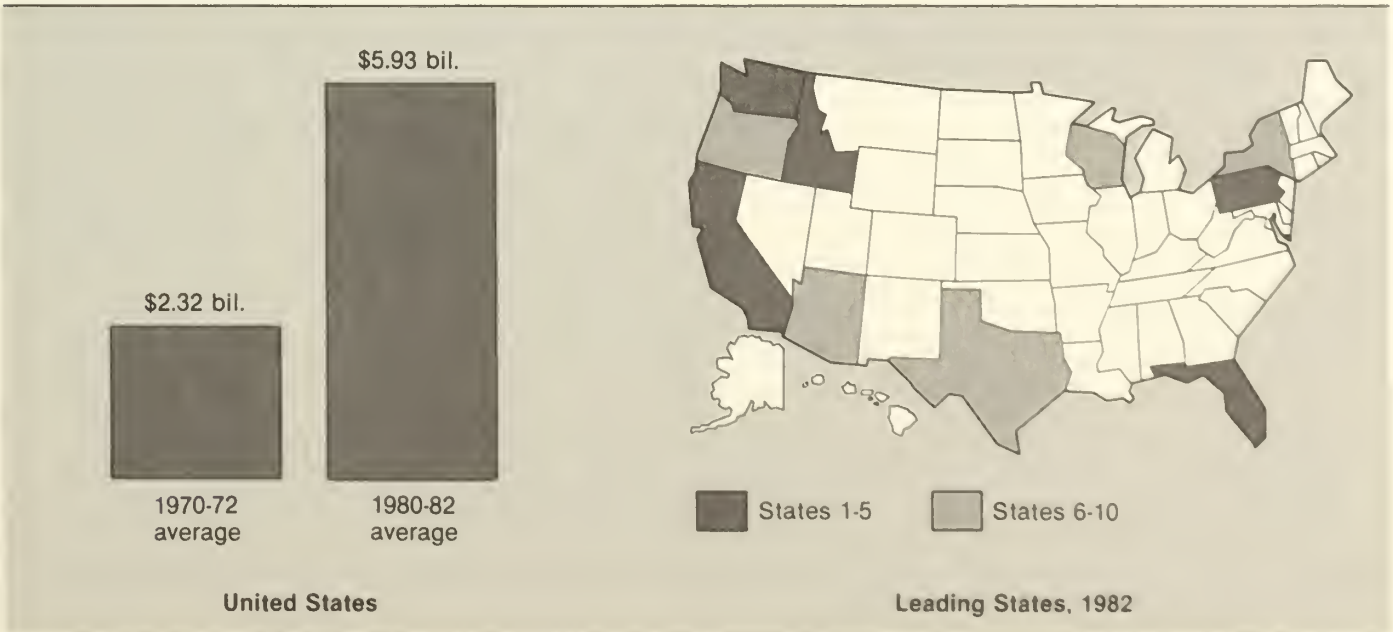
From 1939 through 1968, SRS estimated total vegetable production, excluding home gardens. The definition of production was modified in 1969 to include only the quantity sold or utilized, except for storage onions, potatoes, and sweetpotatoes. For these three crops, production is defined as the quantity harvested from the field and, therefore includes potential shrinkage and storage loss. Commercially dehydrated vegetables are included in the fresh market vegetable estimates.

The current vegetable estimating program, begun in 1982, includes eight fresh market vegetables (broccoli, carrots, cauliflower, celery, sweet corn, lettuce, onions, tomatoes), four processing vegetables (snap beans, sweet corn, green peas, tomatoes), honeydew melons, strawberries, potatoes, sweetpotatoes, and mushrooms. Broccoli, carrots, cauliflower, and strawberries are called "dual purpose" which means that the production is used for either fresh market or processing; acreage cannot be separated for the two uses.

Two of the four processing vegetables (sweet corn and tomatoes) are used for both fresh market and processing, but the acreage and production can be separated between the two uses since most of the processed portion is grown under contract with processors. Fresh market vegetables and processing vegetables are considered different crops and are estimated differently. Differences in production and marketing require different data collection and estimating procedures. In addition, distinctly different varieties of a vegetable are commonly grown for fresh market or processing. Table 6 shows the report title and months in which vegetable reports are issued and table 7, the frequency of estimates by crop.

Fresh market vegetable statistics are based on information collected from growers and shippers. Information

Figure 11. **Value of Production for Vegetables, Potatoes, Sweetpotatoes, and Mushrooms**



on acreage to be harvested is released in January, April, July, and October, giving growers and shippers an indication of vegetable supplies for the quarter. Production estimates are available in July and December.

Processing vegetables are estimated for the crop year. Vegetables processed at home, in institutions, and by commercial dehydrators are excluded from these estimates. Most processing vegetables are grown under contract to processors who take the entire production. Therefore, processors are the main source of information on acreage, yield, and production of processed vegetables.

Fresh Market Vegetables, Melons, and Strawberries

The fresh market vegetable program consists of eight fresh market vegetables, honeydew melons, and strawberries. These crops are produced in 31 States, but California and Florida dominate production.

Data Sources

Personal contact with growers, shippers, grower-shippers, marketing associations, and other knowledgeable sources is the main data collection method in areas where vegetable acreage is highly concentrated. These contacts are supplemented by mail surveys of known growers. Mail surveys are also used to obtain information in less concentrated areas. Sources for developing grower lists for mail surveys are limited only by the imagination of the statistician. Sources include county extension agents, large growers and shippers, and marketing associations.

Quarterly Forecasts

Forecasts of acreage of fresh market vegetables to be harvested are made in January, April, July, and October at the beginning of the winter, spring, summer, and fall quarters. These forecasts are based on knowledgeable industry contacts and nonprobability mail surveys. Farmers are asked to give information about current year's acreage to be harvested and last year's harvested acreage. This information is used to calculate statistical indications, which are interpreted by means of regression or time-series charts.

Forecasts of celery acres planted during the month and growing on the first of the month are made every month for California and Florida, and from April through the end of the season for New York and Michigan. These are in addition to the quarterly forecasts.

Strawberry and spring and summer onion forecasts are on a crop-year basis and are handled in the same basic way as field crops. Acreage for harvest and production forecasts are made during the growing season.

Table 6—**Calendar of vegetable, potato, sweetpotato, and mushroom reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Vegetables												
Monthly	●		●	●	●	●	●	●	●	●	●	
Annual summary[1]						●						●
Mushrooms								●				
Celery	●	●	●	●	●	●	●	●	●	●	●	●
Potatoes and Sweetpotatoes												
Potato stocks	●	●	●	●	●							●
Annual									●			
Crop Production												
Monthly	●	●	●	●	●	●	●	●	●	●	●	
Annual summary	●											
Acreage						●						
Prospective plantings		●										

[1] Two annual summaries are published each year.

Semiannual Estimates

Preliminary January-June estimates of acreage, yield, and production are released in July along with the quarterly forecasts of acreage for summer vegetables. Final January-June estimates and preliminary July-December estimates are released in late December. Acreage, yield, and production estimates for the previous year are finalized in the *Vegetables Annual Summary* report published in June of the following year. Data are collected from farmers on planted and harvested acreage, yield, and production by nonprobability mail surveys and telephone followups of nonrespondents. These indications, combined with indications from knowledgeable sources and check data on volume of movement, are used to set the preliminary estimates. Revised estimates are based on information received from check data sources or additional survey data.

Prices

Prices received by farmers for fresh market vegetables are published monthly in *Agricultural Prices*. The prices reflect those received by growers at the most common point of first sale, usually f.o.b. prices. Estimates for the first half of the current month, used for parity calculations, are usually based on AMS Market News Service quotations. Prices for the whole month are generally obtained from surveys of growers, Market News Service quotations, and other sources. The monthly prices are used in calculating the preliminary value of production.

End-of-season surveys provide the basis for revising monthly prices; these revisions are published, by State, early the following year. Season-average prices are calculated by weighting monthly prices by monthly marketings. Value of production is the product of season-average price multiplied by fresh market production.

Prices for the processing portion of the dual-purpose crops are obtained at the end of the year from processors. The weighted average yearly price reported by processors is applied to the processing portion of the crop to arrive at the value of production. The value of production for fresh market is combined with the value of processing production to arrive at the total value of the dual-purpose crops.

Table 7—**Frequency of vegetable, strawberry, and melon estimates, by crops**

Crop	Acres for harvest, quarterly	Intentions, production, seasonally	Acres, yield, production, and value	
			Semiannual	Annual
Fresh market vegetables				
Celery[1]	●		●	●
Honeydew melons	●		●	●
Lettuce	●		●	●
Sweet corn	●		●	●
Tomatoes	●		●	●
Onions		●		●
Dual-purpose vegetables[2]				
Broccoli	●		●	●
Carrots	●		●	●
Cauliflower	●		●	●
Strawberries		●		●
Processing vegetables[3]				
Green peas		●		●
Snap beans		●		●
Sweet corn		●		●
Tomatoes		●		●

[1]Acres estimated monthly for California, Florida, Michigan, and New York.
[2]Acres, yield, production, and value for total crop. Separate production and value estimates for fresh market and processing annually.
[3]Intentions and production forecasts for "contracted" acreage only. Acres, yield, production, and value for "total crop" annually.

Vegetables for Processing

Estimates are made for seven principal vegetables for processing. Both fresh market and processing production for three of these—broccoli, carrots, and cauliflower—are generally harvested from the same acreage. Thus, estimates are prepared for the total crop during the growing season; but, at the end of the season, separate production, price, and value estimates are made for each use. Acreage cannot be split between the two uses. Processing acreage is estimated separately for snap beans, sweet corn, green peas, and tomatoes since it can be clearly identified. The processed portions of celery, onions, and strawberries are included with fresh market estimates during the growing season. Separate fresh market and processing estimates are published at the end of the season for strawberries.

Data Sources

A complete list of all commercial processors is used to obtain data for estimates of processing vegetables. There are relatively few firms, but there are extreme variations in size and type. Most firms report by returning mailed questionnaires. Followup mail requests, telephone calls, or personal visits are used to obtain reports from nonrespondents. To avoid sending duplicate survey questionnaires to a firm with processing plants located in several States, the SSO located in the same State as the company headquarters obtains data for all of its operations and forwards the information to appropriate SSO's. When a completed questionnaire cannot be obtained, estimates for nonrespondents are added to the enumerated data. Official estimates, for the most part, are summarizations of enumerated data by States for the entire universe. For States where publication would disclose a single processor's data, estimates are grouped together as an "other States" total.

Seasonal Forecasts

Acreage estimates start with an intentions report in March for the four major processing crops—snap beans, sweet corn, green peas, and tomatoes—followed by planting and harvested acreage estimates in June. Contract tonnage estimates for processing tomatoes are also published in March and June. Production forecasts are released about midway through the harvest season: July 1 for green peas, August 1 for snap beans, and September 1 for sweet corn and tomatoes. California tomato production is forecast again on October 1. Forecasts of production are based on processors' opinions of expected yield and the June estimates of harvested acres.

End-of-Season Estimates

Processors obtain most of their raw product through contracts with growers and from their own farms. They also buy on the open market if supplies are needed and available. However, open-market purchases cannot be accurately determined until the end of the growing season. Season-end estimates are a total of processor-owned, grower-contracted, and open-market purchases.

The December *Vegetables Annual Summary* includes estimates of vegetables canned and frozen. These estimates are limited to national totals to avoid disclosure of individual operations.

Prices received by farmers for processing vegetables are an equivalent packinghouse-door price. All payments to growers plus the cost of materials and services furnished by the processors and not charged to the grower for getting the raw product to the processor's plant door are included.

Potatoes

Estimates of Irish potato production were first published in 1841; estimates of acreage and yield began in 1862. Until 1909, potato estimates were limited to acreage, yield, production, and prices reported annually. Estimates of farm disposition and season-average prices began in 1909 and monthly forecasts of potato production began in July 1912. Potato stocks reports were added in 1924.

Sweeping changes were made in 1956. The commercial production concept was dropped and estimates of total production initiated for all States. A new stocks program included supplies in storage on the first of December, January, February, and March. Disposition estimates began to show quantities sold for table stock, processing, livestock feed, and seed. Annual processing surveys enumerated the amounts of potatoes utilized for various frozen, dehydrated, and canned products along with chips, starch, and flour.

Probability sampling techniques in potato estimates were started in 1971 to improve forecasts for the important fall crop. Multiple-frame surveys are used to estimate planted acreage and objective measurements to establish yield per acre. Estimates for April 1 stocks were also added to the program in 1971. May 1 stocks were added in 1978.

SRS prepares seasonal quarterly production estimates by States. The fall quarter accounts for about 87 percent of U.S. production, the spring and summer quarters each represent about 6 percent, and the winter crop accounts for about 1 percent. Potatoes are grown in most States, but Idaho, Washington, and Maine produce about half the Nation's crop.

All estimates are released in the monthly *Crop Production* report, except those dealing with disposition and stocks, which are issued separately in reports titled *Potatoes and Sweetpotatoes*. See table 6 for a calendar by report title and table 8 for details of the frequency and geographic coverage of the reporting program.

Acreage Estimates

Estimates of growers' acreage planted and acreage for harvest, coupled with forecasts of yield, are the fundamental building blocks of this program. The general statistical procedures for developing this information are similar to those for other field crops.

In many States, farmers report their current and preceding year's acreages on nonprobability mail survey questionnaires. These reports are used to compute C/H ratios. Acreages reported on the current year's questionnaires are also matched with data reported the previous year for computation of C/C ratios. Both indications are interpreted by use of regression and time-series analyses to arrive at acreage estimates.

Additional acreage data are developed for the fall crop through probability sampling techniques, including application of multiple-frame methods. The list portion of the multiple-frame is made up of approximately 7,000 producers in the 11 major producing States (Maine, New York, Pennsylvania, Michigan, Wisconsin, Minnesota, North Dakota, Colorado, Idaho, Washington, and Oregon) who account for over 90 percent of U.S. fall potato acreage. Producer lists are updated each year. The lists are stratified according to size of producer and a systematic random sample is selected. Growers with large potato acreages are more likely to be selected than growers with small acreages. Producers with 200-600 acres or more (depending on the State) are completely enumerated each year. Smaller growers are selected with reduced frequency, as few as one out of every seven. Current survey data from the sample of selected growers is then expanded to provide direct expansion estimates of total acres of potatoes for the growers on the list.

To estimate for growers not on the list frame, SRS uses data from the JES. Any potato acreage from this area frame survey not associated with a producer on the list is expanded by the JES expansion factor. These two sets of expanded data, when added, indicate total acreage for each State. The area frame accounts for approximately 10 percent of the total potato acreage in these 11 States. Harvested acreage estimates based on information from this survey are published initially in the July *Crop Production* report.

Yield Estimates

Yield forecasts are made during the growing season, based on current crop conditions and prospects. Growers are asked questions in nonprobability mail surveys relating to local conditions and yield per acre for individual farms.

Objective measurements, in addition to the mail survey data, are used to determine yield at harvest time in the 11 major States. Acreage reported during the multiple-frame survey is used as the sampling frame. About 2,100 sample fields are selected from this frame. For each sample, two small plots are randomly located and potatoes are dug just prior to harvest. Information from the harvested samples is used to estimate production in October and December.

Figure 12 illustrates a potato sample unit laid out in one row for objective measurement of yield. It shows the location of the three sample hills to be dug between the 5-foot and 25-foot marks in the count section.

Enumerators record the number of tubers and weight from these three sample hills and measure the width across four row spaces (five adjacent potato rows) from the center of the stems in row one to the center of the stems in row five. Gross yield per acre is derived by multiplying the computed number of hills per acre times the average weight of potatoes per hill.

Figure 12. **How Sample Hills Are Chosen for Objective Measurement of Potato Yield**

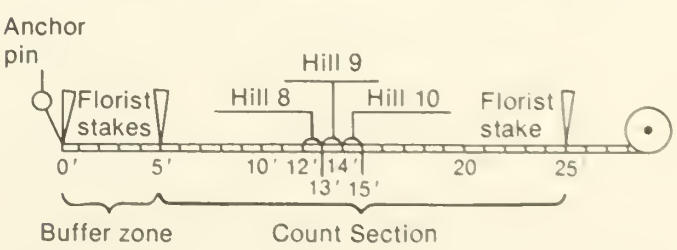


Table 8—**Program of reports on potatoes and sweetpotatoes**

Month of estimate	Winter potatoes	Spring potatoes	Summer potatoes	Fall potatoes	Sweet-potatoes
			Item		
January	AH,F	R		S	
February	F			S	
March	F	AH	R	S	I
April		F		S	
May		F		S	
June		F			
July			AH,F	AH	AH,R
August			F		F
September	D	D	F,D	R,D	F,D
October	R			F	F
November					
December				F,S	
States:	California Florida	Alabama Arizona California Florida Louisiana N. Carolina Texas	Alabama California Colorado Delaware Illinois Indiana Iowa Maryland Michigan Minnesota Nebraska New Jersey New Mexico N. Carolina Ohio Tennessee Texas Virginia	California Colorado Connecticut Idaho Indiana Maine Massachusetts Michigan Minnesota Montana Nebraska Nevada New York N. Dakota Ohio Oregon Pennsylvania Rhode Island S. Dakota Utah Vermont Washington Wisconsin Wyoming	Alabama California Georgia Louisiana Maryland Mississippi New Jersey N. Carolina S. Carolina Tennessee Texas Virginia

Key: I = Intentions to plant
AH = Acres for harvest
F = Forecasts of yield and production
R = Revised estimates of acreage, yield, and production, published in *Crop Production*
D = Disposition and utilization of previous crop year, published in *Potatoes and Sweetpotatoes*
S = Stocks, published in *Potatoes and Sweetpotatoes*

A small plot being layed out in a potato field that has been randomly selected for objective yield measurement. Potatoes from several plants in this count unit, dug and weighed just prior to harvest, will provide statisticians with one indication of likely potato yields.

Gross yields indicated by the samples are adjusted for harvest losses based on data collected by enumerators who revisit the objective yield fields after harvest and lay out sample units to determine the amount of the crop left in the field. The average net yield of all samples, together with producer postharvest interviews, disposition surveys, and shipment and processor data provide the basic data for making estimates of production.

Production Estimates

Three forecasts of production are issued for the winter, spring, and summer seasonal groups of potatoes. These forecasts coincide with the most active harvesting periods. Fall potato production is forecast in October and again in December after harvest is complete. Allowances are made for acreages abandoned because of weather or economic reasons. Estimates are revised after the marketing season when final grower reports and check data are received. A final summary including crop disposition and utilization data is released in September following the year of production.

AMS Market News Service reports on rail and truck shipments or truck unloads of potatoes at certain markets are used to check production where recorded movement constitutes a significant percentage of a State's production. State inspection records and other recorded movement along with market order information are also used. In addition to data on fresh shipments, an enumeration of the volume of potatoes processed in major States helps establish total production estimates. Farm disposition and utilization estimates are based on special grower surveys in most States.

Stocks Estimates

Potatoes harvested from January through September normally cannot be stored for long periods and are moved to market as soon as dug. However, most of the fall crop is placed in storage and is the principal source of marketings from October through May. SRS issues monthly reports of stocks held by local dealers, processors, and growers in fall producing areas, by States, from December through May. These estimates aid producers, processors, and dealers in judging supplies on hand as the marketing season progresses.

Stocks estimates are based on storage reports from dealers and farmers and on Market News Service recorded movement and processor utilization data. SRS estimates of potato stocks reflect changes in supply as a result of sales for all purposes, potatoes eaten or fed on farms where produced and lost through shrinkage, and potatoes decayed or discarded. The stocks indications are compared closely with shipment check data in arriving at State stock estimates.

Reliability

Reliability of potato estimates is expressed in terms of root mean square error (RMSE), a statistical measure of past performance. The percentage deviations between forecasts and final estimates are squared and summed for the past 20 years and then averaged. The square root of this average becomes the RMSE, which was 2.5 percent for the October 1982 fall potato production forecast. This meant that chances were 2 out of 3 that the October forecast would not be above or below the final estimate by more than 2.5 percent. At the 90-percent confidence level, the RMSE was 4.3 percent. The December preliminary production RMSE's were 1.5 and 2.6 percent at the 66.7- and 90-percent confidence levels, respectively. The accuracy of the potato stocks estimates from December 1 through March 1 ranges from 2 percent to 3.6 percent at the 66.7-percent confidence level. Accuracy at the 90-percent confidence level ranges from 3.5 percent to 6.3 percent.

Sweetpotatoes

Sweetpotato production is concentrated in the Southern States with North Carolina and Louisiana providing

over one-half the U.S. output. Harvest is most active in September and October. Estimates for sweetpotatoes began in 1868 with annual acreage, yield, production, and price estimates. Reporting of farm disposition and season-average prices started in 1909. Monthly production forecasts were added in 1912.

The present reporting cycle begins with release of planting intentions in February, followed by acreage planted and expected for harvest in June. Forecasts of yield and production are published in August, September, and October. Disposition estimates are published in September of the following year.

Acreage Estimates

Basic indications for establishing acreage estimates for sweetpotatoes are collected by nonprobability mail surveys to general farmers as well as a specialized list of known producers. The February survey asks about acreage planted or intended for the current year and that planted the previous year. In June, similar surveys are conducted for determining the actual acreage planted. Growers report current year's planted acreage and the acres harvested the previous year on the same questionnaire. Acreage reported on the current year's questionnaires are also matched with data reported the previous year. These reports are used to computed C/H and C/C ratios for each crop reporting district which are weighted by the relative importance of sweetpotatoes in each district (usually acres harvested the previous year) to obtain weighted ratios at the State level. These weighted ratios, applied to the previous year's acreage, indicate current acreage. These indications, charted against comparable indications for previous years, as well as expanded indications plotted on time-series charts, are used to set acreage estimates.

Expected acreages for harvest are based on historical relationships between planted and harvested acreage. These estimates may be adjusted throughout the forecast season if weather or economic conditions force producers to abandon acreage.

Yield and Production Forecasts

Production is computed from estimates of acreage and yield per acre. Forecasts are published in August, September, and October based on grower reports of crop condition and expected yields. In November, growers are asked to report actual acreage harvested and production. These indications and other check data provide the basis for estimates released in the January *Crop Production Annual Summary*.

Disposition estimates are issued in September following the production and marketing season. Revisions are also considered after marketing and price data are finalized.

Mushrooms

The estimating program for commercial mushrooms began in 1966 for Pennsylvania, Delaware, and Maryland. Nationwide coverage began in 1967 and now includes 26 States. About one-half of the U.S. crop is grown in Pennsylvania. Most of the remaining production is concentrated in the Northeast and the West Coast.

The program provides estimates of total growing area, production, and value, as well as volume and value of sales for both fresh market and processing. Growers' production intentions for the next year are also provided. Growers in Pennsylvania are asked to report fresh market pack, sales to brokers and repackers (for fresh and for processing use), and direct sales to canners or freezers. In addition, a special survey of all brokers and repackers is conducted to determine actual utilization of production. All information is obtained from an annual survey conducted in late June for a July-through-June marketing year. The results are published in August in the *Mushrooms* annual report.

Data Collection

Mail questionnaires are used to survey growers and processors. Followup telephone and personal interviews are made to firms not responding. Survey coverage is essentially a complete enumeration of both growers and processors.

SSO's use trade associations, State governments, universities, and other related sources to update grower and processor lists. Grower questionnaires are designed with space for growers to provide names and addresses of new producers in their areas. For firms with multistate operations, the SSO of the State in which the firm's headquarters are located obtains data from the firm for all States.

Estimates

State estimates are developed using data collected from the firms reporting plus an allowance for nonresponding growers and processors. Separate summaries of grower and processor reports are compiled, with the growers' survey providing the primary indications and the processor reports serving as a check on possible incompleteness in coverage of the growers.

Chapter 6

Fruit and Tree Nuts

Introduction

USDA issued condition reports on fruit and nuts beginning in 1866. This reported condition was expressed as "percent of full crop" with a full crop defined as expected production if there were no damage from weather, insects, disease, or other factors. Beginning in 1914, the condition percentages were converted to quantitative production estimates.

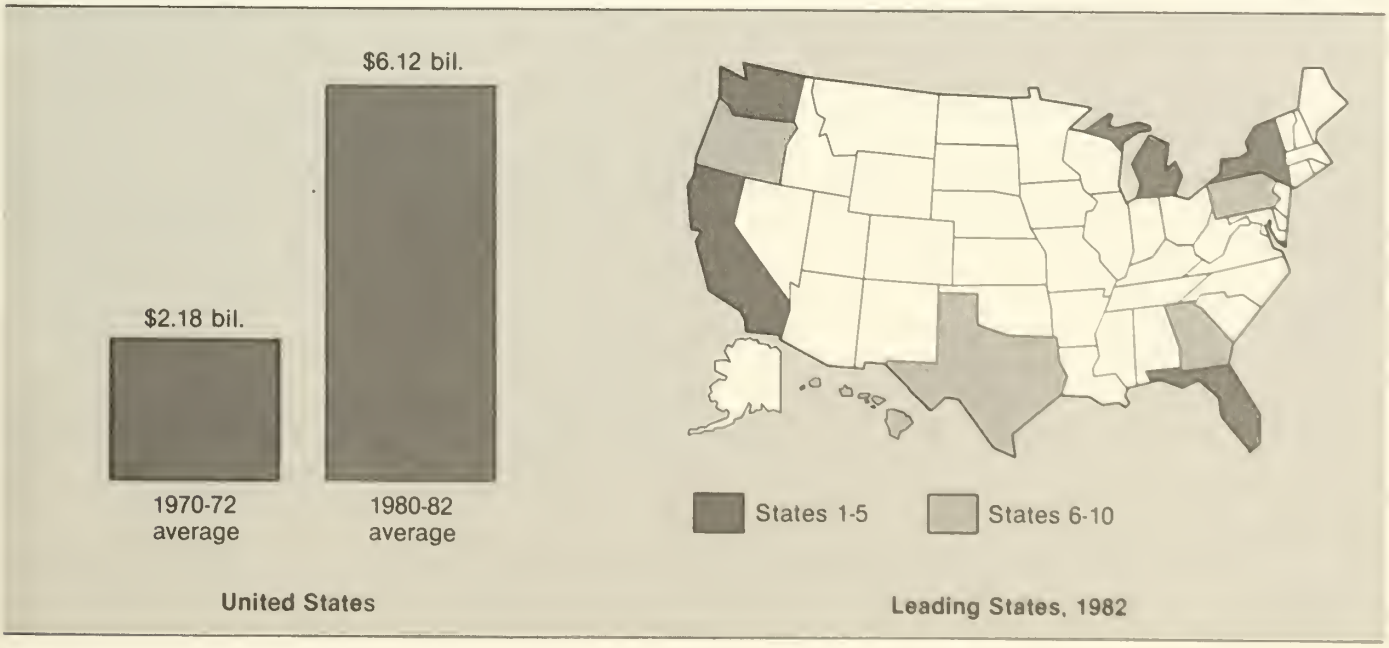
The present fruit and tree nut estimating program consists of production forecasts and production and utilization estimates for 17 noncitrus fruits, 7 citrus fruits, 6 tree nuts, and 8 Hawaiian and miscellaneous fruits. The program covers 44 of the 50 States where there is production of any of these crops. Separate type or variety estimates are made for the following crops: cherries, grapes, peaches, pears, plums and prunes, oranges, grapefruit, and pecans.

Production forecasts begin when the crop normally reaches a stage of development allowing prospective output to be either subjectively judged or objectively measured. Estimates generally continue through the growing and harvest season. Many production forecasts are judgment-based, relying on grower-reported crop condition or expected production obtained by mailed survey questionnaires. Statisticians correlate these current-season indications with production using regression or time-series analysis. Production forecasts for Florida citrus; Michigan tart cherries; California almonds, walnuts, and pistachios; and Oregon filberts are made using objective measurement surveys and forecasting models. For some crops, SRS collects and publishes additional information such as fruit or nut size, percent sound or marketable, grades and color, and production by varieties.

Definitions and Units

All noncitrus fruit and tree nut estimates are expressed in pounds or tons as standard units of measure. For all noncitrus crops, estimates are published for both total and utilized production. Beginning in 1982, total production estimates include unharvested production and harvested production not sold or utilized including losses for economic as well as natural reasons. Noncitrus fruit and tree nut forecasts and estimates are for a specific crop year as both bloom and harvest take place in the same year.

Figure 13. **Value of Fruit and Tree Nut Production**



Citrus fruit estimates are published in terms of both boxes and ton-equivalents. The citrus and avocado crops are designated by year of bloom and year of harvest. For example, the 1982-83 crop refers to the bloom of 1982 and harvest of 1983. Since harvest takes place primarily in the year following bloom, production and value statistics are included in the calendar year of harvest. The opposite is true for avocados, where crop statistics for the 1982-83 marketing season are included in calendar year 1982.

Schedule of Estimates

Production forecasts for noncitrus fruit and tree nuts are released monthly during the growing season in the *Crop Production* report. Production, utilization, price, and value estimates for most noncitrus fruit are published in January in the *Noncitrus Fruits and Nuts Annual Summary*. Final utilization, price, and value data for fruit crops that can be stored such as apples, grapes, and pears; and other crops such as tree nuts for which marketing is not complete by January; are published in July in the *Noncitrus Fruits and Nuts Midyear Supplement*. See table 9 for a calendar of fruit and nut reports by report title and table 10 for a schedule of noncitrus fruit and nut estimates.

Forecasts of the citrus crop are released monthly during the growing and harvest season in *Crop Production*. Forecasts of production start in September and end in July. In September, estimates of production, utilization, price, and value for the previous season are published in *Citrus Fruits*. Citrus fruit estimates are also included in the January *Crop Production Annual Summary*. See table 11 for a schedule of citrus fruit estimates.

General Methods

While both nonprobability and probability surveys are used to gather data for fruit and tree nut production, nonprobability surveys are used in most cases.

Nonprobability Surveys

Questionnaires for nonprobability mail surveys are sent to a sample of growers. Telephone followup is often used to get information from those producers not responding by mail. Data are summarized by production areas within the State or by size of operation to give a relative weight factor to each report.

Forecasts are based primarily on grower-reported condition of the crop as a percentage of a full crop. In addition, growers may be asked information on expected production versus actual production for the previous year (C/H). These indications are plotted on charts and analyzed to arrive at the forecasts, as illustrated by fig. 14.

End-of-season production and disposition surveys are conducted in the same manner. The emphasis on indications changes, however, so that percentage change from previous year, expanded yield per unit, fresh sales versus processed volume, and available check data are much more important in establishing end-of-season estimates than reported crop condition. Information on total production, harvested production, utilized production, and

Table 9—**Calendar of citrus, noncitrus fruit, and tree nut reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Citrus Fruits									●			
Noncitrus Fruits and Nuts												
Annual summary	●											
Midyear supplement							●					
Crop Production												
Monthly	●	●	●	●	●	●	●	●	●	●	●	●
Cherries—June 15						●						
Cherry Utilization										●		
Cranberries								●				

Table 10—**Noncitrus fruit and tree nut estimates**

Commodity	Jan.1 through Apr.1	May 1	June 1 ~	June 15	July 1	Aug. 1	Aug. 15	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 15	May 1	July 1
						Item								
Noncitrus fruit:														
Apples					F	F			F			P		P,U
Apricots			F		F							P,U		
Avocados (CA-FL)														P
Bananas (HI)												P,U	P	P,U
Cherries, sweet														
Western States (CA only May 1)		F	F	F	F				P,U			P,U		
Great Lakes States				F					P,U			P,U		
Cherries,tart														
Western States			F		F				P,U			P,U		
Great Lakes States				F[1]					P,U			P,U		
Cranberries							F,P,U				P			
Dates (CA)												P		P,U
Figs (CA)												P		P,U
Grapes														
CA					F	F		F	F			P,U		P,U
Other, excl. CA						F		F	F			P,U		P,U
Kiwifruit (CA)												P		P,U
Nectarines (CA)		F			F							P,U		
Olives (CA)					F							P,U		
Papayas (HI)	F	F	F		F	F		F	F	F	F	P,U	P	P,U
Peaches														
CA			F		F	F						P,U		
9 Southern States		F	F		F							P,U		
Other			F		F	F						P,U		
Pears, Bartlett (WA, OR, CA)			F,P		F	F		F				P,U		
Pears, other (WA, OR, CA)					F	F		F				P		P,U
All pears (excl. WA, OR, CA)					F	F		F				P,U		
Pineapples (HI)												P,U		P,U
Pomegranates (CA)												P,U		
Plums (CA)			F		F							P,U		
Prunes (CA)			F,P		F			F		F		P		P,U
Prunes and plums (excl. CA)						F		F	F			P,U		
Tree nuts:														
Almonds (CA)		F	F		F[1]							P		P,U
Filberts (OR,WA)								F[1]	F	F		P		P,U
Macadamias (HI)												P		P,U
Pecans (11 Southern States)								F	F		F	P		P,U
Pistachios (CA)						F[1]						P		P,U
Walnuts (CA)					F	F		F[1]				P		P,U

[1] Based on objective measurement survey.
Key: F = Forecast of production (Pistachios effective in 1984)
P = Estimate of production (end-of-season)
U = Utilization

Table 11—**Citrus fruit estimates**

Commodity	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1	Sep. 25
							Item					
Oranges, early, midseason, and Navel:												
Arizona		F		F	F	F	F					P,U
California		F		F	F	F	F	F	F	F	F	P,U
Florida		F[1]		F[1]	F[1]	F[1]	F	F	F	F	F	P,U
Texas		F		F	F	F	F	F				P,U
Oranges, Valencia:												
Arizona		F		F	F	F	F	F	F	F	F	P,U
California		F		F	F	F	F	F	F	F	F	P,U
Florida		F[1]		F[1]	F[1]	F[1]	F[1]	F[1]	F	F	F	P,U
Texas		F		F	F	F	F	F	F	F		P,U
Grapefruit:												
Arizona		F	F	F	F	F	F	F	F	F	F	P,U
California,												
Desert areas		F	F	F	F	F	F	F	F	F	F	P,U
Other areas								F	F	F	F	P,U
Florida		F[1]		F[1]	F[1]	F[1]	F	F	F	F	F	P,U
Texas		F	F	F	F	F	F	F	F	F		P,U
Lemons:												
Arizona	F[1]	F	F	F	F	F	F	F				P,U
California[2]	F[1]	F	F[1]	F	F	F	F[1]	F	F	F	F[1]	P,U
Limes, Florida												P,U
Tangelos, Florida		F[1]		F[1]	F	F	F	F	F	F	F	P,U
Tangerines:												
Arizona		F	F	F	F	F	F	F				P,U
California		F	F	F	F	F	F					P,U
Florida		F[1]		F[1]	F	F	F	F	F	F	F	P,U
Temples, Florida		F[1]		F[1]	F[1]	F[1]	F	F	F	F	F	P,U

[1] Based on objective measurement survey.
[2] September 1 forecast for California desert areas only.
Key: F = Forecast
P = Estimate of production
U = Utilization estimate

disposition of sales are obtained after the end of the marketing season.

Probability Surveys

Two types of probability surveys are used to improve the accuracy of forecasts and estimates. These are sample mail surveys allocated proportional to size and objective yield measurements (actual field counts and measurements).

The probability sample survey proportional to size has two major advantages over a simple random sample. It is self-weighting and allows a more representative sample of growers to be surveyed. In addition, extensive followup by telephone and personal interview of all nonrespondents in the selected sample are conducted to assure statistical completeness for all size groups. The indications from this type survey are analyzed in the same way as a nonprobability sample.

Objective measurement surveys remove the bias associated with information based on grower opinions and eliminate the selectivity of voluntary mailed responses. The probability sample employed by the objective measurement procedure permits a measure of relative precision to be calculated. The estimating components required for making a directly expanded estimate of fruit production based on objective measurement techniques are:

- Number of bearing trees or acres in the population,
- Average number of fruit per tree or per acre,
- Size and weight of fruit at maturity,
- Natural loss of fruit between time of fruit count and maturity, and
- Harvest loss.

In designing an objective yield survey, an up-to-date list or inventory of orchards and accurate count of trees by variety, age, and acres and their geographic location are required. Aerial photography, administrative records, and fruit-tree census tabulations are the most frequently used sources of this information.

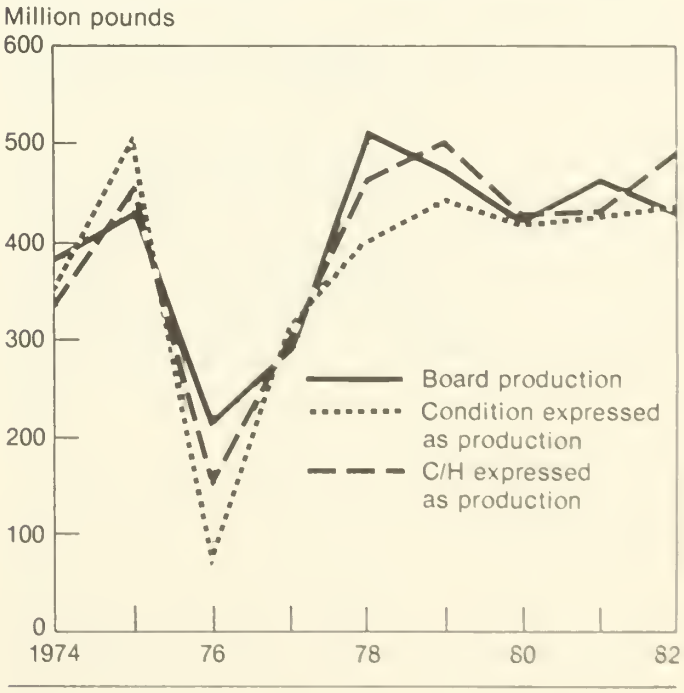
The bearing surface of a tree or limb is closely related to the cross-sectional area at its base. Sample limbs are randomly selected with known probabilities to represent the bearing surface. The average number of fruit per tree is calculated from counts on the selected sample limbs expanded by the bearing surface of the tree.

Fruit on the sample limbs are counted, weighed, and measured. Fruit size is projected to maturity by growth curves, which project the usual growth and development of fruit between the initial observation, which is at varying stages of development, and maturity.

The theoretical example (fig. 15) illustrates selection of a terminal limb for fruit counts and the estimation of fruit for the entire tree from these counts. This example applies to fruit in general. Fruit counts as described in this example are made on a randomly selected sample (terminal) limb. This process of selecting the limb for fruit counts is known as the "random-path" technique. The sample limb has a probability of selection that is determined by calculating probability proportional to limb cross-sectional area (CSA) at each stage of the selection. The number of fruit on the sample limb is multiplied by the reciprocal of the sampling fraction, which gives an unbiased estimate of total fruit on the tree.

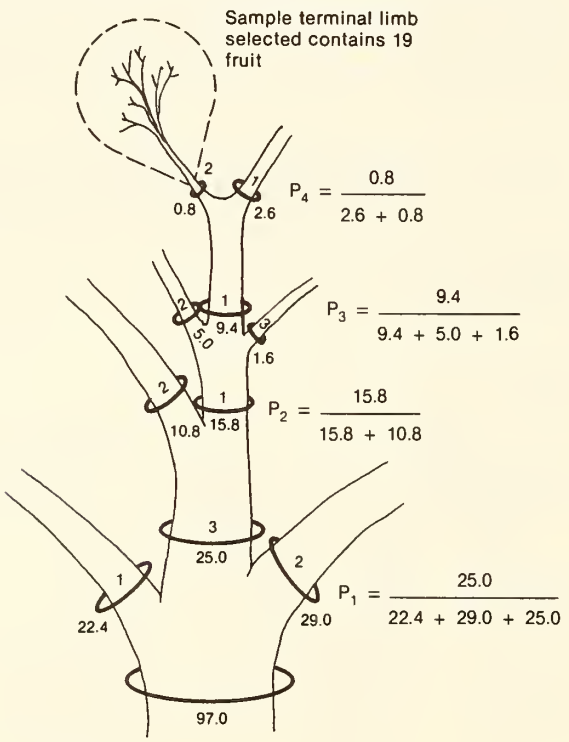
The first major branches are measured with a tape which shows CSA inches. The CSA for each limb and cumulative CSA inches are recorded. A number from 1

Figure 14. **Example of a Time-Series Chart Used to Measure a State's Apple Production**



to 76.4 is selected from a random-number table to determine the individual branch selected (see fig. 15). In this example, a number of 74 resulted in the selection of the primary branch 3 measuring 25 square inches. At the next branching area, a random number between 1 and 26.6 was selected. The selected random number of 6.8 resulted in the selection of branch 1 measuring 15.8 squares inches. The measuring and random selection process is repeated at the next and succeeding branches until a terminal branch is selected (the terminal branch in this example is required to have a CSA of 0.8 square inch or less). The number of times this random selection process is repeated depends on the size of the tree. The count of fruit on selected terminal branch number 2 was 19. The sample count of 19 is multiplied by the reciprocal of the probability of selection to give the estimate of 707 fruit on the tree. Adjustments are made in these counts to allow for the natural (normal) droppage of fruit between survey date and harvest. A sample of fruit from the terminal branch is weighed. Taking into account the timing of the survey and prior study of the growth of fruit, the weight of fruit is projected to a harvest weight.

Figure 15. **Random Limb Selection with Probability Proportional to Cross-Sectional Area**



Estimated fruit per tree =

$$\text{Fruit count} \times \frac{1}{P_1} \times \frac{1}{P_2} \times \frac{1}{P_3} \times \frac{1}{P_4} =$$

$$19 \times \frac{22.4 + 29.0 + 25.0}{25.0} \times \frac{15.8 + 10.8}{15.8} \times \frac{9.4 + 5.0 + 1.6}{9.4} \times \frac{2.6 + 0.8}{0.8} = 707$$

The estimates of number of fruit per tree and weight per fruit are multiplied to determine weight of fruit per tree. The tree data are then multiplied by number of bearing trees in the State to estimate fruit production at the State level.

Additional adjustments must be made to the direct-expansion estimate to account for losses that will occur after the initial count and through harvest. An estimate is made for these losses, based on prior surveys. Sampling error for estimated weight of fruit per tree is computed from the variability between the sampled orchards.

Noncitrus Fruit

Monthly production forecasts are made for noncitrus fruit beginning in May (except for Hawaiian papayas) and continuing through November. See table 10 for the noncitrus fruit and tree nut estimate dates. These forecasts are based on responses to a mail survey of producers. Condition as a percentage of full crop is the most common indication, but percentage change from the previous year and expanded yield are also used. Indications are interpreted by means of charts which account for acreage and yield trends.

For some crops, supplemental industry funds are used for objective measurement surveys to forecast production. Some States use data from both a mail survey and objective measurements to make production forecasts. Michigan is the only State currently conducting an objective measurement survey on noncitrus fruit. Prior to 1983, California conducted grape and clingstone peach objective measurement surveys. South Carolina is currently conducting a pilot study on freestone peaches.

End-of-Season Estimates

The end-of-season estimates establish preliminary production, utilization, price, and value figures for most noncitrus fruit and tree nut crops and are published in the *Noncitrus Fruits and Nuts Annual Summary* in January. Data on final production, utilization, and prices are collected from growers and processors using mail surveys. These data, along with data on crop movement, inspections, and any other check data source (such as grower associations, administrative committees, or cooperatives) are used to set the end-of-season estimates. Preliminary estimates are normally unchanged as

there are usually very little new data to support revisions. Annual estimates are presently made for avocados, bananas, pineapples, kiwifruit, dates, figs, and pomegranates.

Final utilization and price for fruit that can be stored such as apples, grapes, and pears cannot be established in January. Therefore, it is necessary to collect the data later in the year and publish results in July in the mid-year supplement.

Cranberries can also be stored; hence, utilization and price are not available until late in the market season. The utilization and price estimates are issued in August the year following harvest along with the only forecast of production for the current crop.

Citrus Fruit

In Florida, Texas, Arizona, and California, monthly forecasts are made during the growing season for oranges, grapefruit, lemons, tangerines, temples, and tangelos. An annual estimate is made for limes (see table 11). Orange estimates are for early and midseason varieties including navels as one kind, and for Valencias as a second. In California, grapefruit are estimated for the desert areas and "other" areas. In Florida, estimates are made for three types of grapefruit and two varieties of tangerines.

Forecasts of most citrus fruit production in Texas, Arizona, and California are primarily based on subjective data reported by growers in mail surveys. Indications are interpreted graphically as described in the noncitrus fruit section on nonprobability sampling methods. Data are also analyzed with the use of time-series charts.

Florida Orange Objective Survey

In Florida, an objective limb count survey for oranges is conducted in August and early September to estimate the number of fruit set on the trees at that time. Selection of terminal limbs and expansion of fruit counts are determined, using a random-path technique.

The terminal limb represents approximately 10 percent of the total cross-sectional area of the primary limbs. Since the limb count survey is conducted 7 to 8 months prior to harvest, these counts are adjusted for natural loss of fruit and fruit sizing with a sequence of monthly surveys. Sample trees for the size and drop survey are drawn from a sampling frame consisting of all bearing groves fronting on a 1,500-mile route traversing the most important citrus counties.

The difference between the initial survey counts in August and later ones indicates droppage to the time of the forecast month. Monthly drop rates are adjusted by the estimated proportion of total crop harvested by the survey date. This adjusted droppage is then projected for the entire season using historic relationships.

The fruit size survey coincides with the drop survey. Circumference measurements are linearly correlated with fruit weight. Immature fruit measurements are projected to harvest size, using historic growth curves. A multiple-regression formula is used to convert volume per fruit to number of fruit constituting a box (90 pounds for oranges).

Two forecasting models are used to estimate production. One model is a direct-expansion estimator, described earlier, which incorporates the number of trees of bearing age, initial fruit counts, projected droppage, and projected size into an indication (boxes of fruit). This estimator is interpreted by means of multiple-regression formulas. A second model, called a volume expansion, uses the initial fruit counts from the limb count survey in August and adjusts for survey-measured droppage and size for each forecast month. The resulting indication is interpreted graphically, using a multiple-regression formula in which each current month's forecast indication is correlated with final production in previous years. An additional indication of production for the October 1 forecast is the fruit population expansion. This is a simple expansion of the fruit counts on sample trees to the entire universe which is correlated in a regression formula to previous years.

After harvest is well advanced, a row count survey is conducted monthly, using the 1,500-mile-route sampling frame. This survey is based on a visual evaluation of the proportion of rows picked in a sample of groves correlated with the volume of fruit actually delivered to processors. Although biased, this survey provides a reliable basis for revising forecasts when harvest is past midpoint.

Another related survey using the route frame is a maturity and yield survey, which provides objective estimates of percentage of acid, percentage of soluble solids (brix), pounds of (unfinished) juice per box, and pounds of solids per box for the fruit sampled.

In the event of a severe freeze, special objective procedures for a sample of trees are used to measure the ex-

tent of damage. With objective data available for the identical sample of trees prior to and after a freeze, a reappraisal of the crop can be made accurately and swiftly. Basically, the extent of damage can be measured by a relatively small sample in which selected fruit is cut, extent of damage is recorded, tree condition is noted, and droppage is evaluated.

California Lemon Objective Survey

A lemon objective yield survey is conducted in southern California coastal areas three times a year with fieldwork conducted in mid-October, mid-February, and mid-June. Surveys are conducted once in mid-August for Arizona and the desert area of California and in mid-September for the San Joaquin Valley. Expected harvest in the southern coastal area, which accounts for over 75 percent of California's production, is projected in 2-month increments for a year in advance. Size, color, and grade distribution of lemons sampled are also observed.

The projected pick is based on the number of lemons on the sample trees, adjusted by weight and diameter measurements. Survey indications are expanded to an average yield for the area by interpretation from a multiple-regression formula. The predicted yield times the bearing acreage estimate provides the production estimate for a particular period.

End-of-Season Estimates

After harvest each season, the actual quantities of citrus marketed are ascertained. In Florida, records accounting for over 95 percent of the fruit produced are available from administrative sources. Estimates of both volume of fresh fruit sold locally and consumed on farms where produced are added to this recorded movement to establish total production. These data provide the basis for checking the accuracy of the forecasts made during the harvest season. Final production and utilization estimates are established in the same manner in other States where commercial movement data are obtained from grower associations, cooperatives, and administrative committee reports for Federal marketing orders.

Tree Nuts

Monthly production forecasts commence for almonds in May, for pistachios in August, for walnuts in July, and for filberts and pecans in September (see table 10). An annual estimate for macadamia nuts is prepared in January.

Forecasts in most months are based on growers' reports of condition and expected change in production from the previous year, supplemented with production data from handlers, processors, and shellers. The condition indication is interpreted graphically from regression formulas and adjusted for trend as described previously. Indications are also analyzed on time-series charts.

In-season objective measurement surveys are conducted for almonds, pistachios, walnuts, and filberts and are used in making production forecasts. Selection of terminal limbs to make nut counts for almonds, filberts, and pistachios is based on a random-path approach. The large size of walnut trees makes it necessary to select a reachable branch to make nut counts. Objective surveys are scheduled when individual nuts have reached mature size. However, the number of nuts which may drop from the date of the initial count to harvest and losses during harvest is still an unknown variable. A sample of nuts from the terminal limb is picked to be measured and weighed at a field sizing station. These indications are interpreted using multiple-regression formulas which correlate the survey counts with final yield per acre. The predicted yield indication is multiplied by the current estimate of bearing acreage for an indication of production.

End-of-Season Estimates

Preliminary end-of-season estimates for tree nuts based on grower deliveries to date to handlers are released with the noncitrus fruits in the *Noncitrus Fruits and Nuts Annual Summary* published in mid-January. This is approximately 2 months after harvest is complete for almonds, walnuts, filberts, and pistachios. Harvest for pecans and macadamia nuts is normally complete by the end of December. An allowance is made in the preliminary estimate for deliveries for the remainder of the marketing season.

Final production estimates at the end of the marketing season are released in the *Noncitrus Fruits and Nuts Midyear Supplement* published in early July. These final estimates are based on receipts reported by all handlers, processors, and shellers who report total weight and price of nuts received. The final production estimates for all tree nuts include a small allowance for unrecorded sales and farm use.

Tree Inventory Surveys

There is no continuing national program of estimates of fruit and nut tree numbers, vines, or acreage because of

the high cost of such surveys. Surveys are most extensive in California, Florida, and Texas where States contribute heavily to the SRS program.

California has a long-time series of tree and vine acreages by age, county, and variety. County agricultural commissioners continually prepare estimates of plantings, removals, and any acreage changes by variety and age groups. These estimates supplement a program in which one-fifth of the counties are enumerated each year. Data from the county agricultural commissioners are used for the other four-fifths of the counties in nonsurvey years. Each spring since 1972, California has conducted a special grape acreage survey of all known and potential grape growers to ascertain plantings and removals on a calendar-year basis.

Use of aerial photography for tree inventory surveys has application in areas where orchards and vineyards are concentrated. Although the initial survey is very expensive, use of aerial photography is a quick and cost-effective method for updating a tree inventory, particularly if there are many absentee owners. Aerial photography has certain limitations, however. Determination of the age, variety, and, to some extent, the kind of trees is usually not possible from aerial photography alone; ground surveys to make these determinations can be very costly.

In 1982, California began using current aerial photography in some counties to obtain up-to-date tree inventory information. In 1965, Florida began indexing citrus groves by aerial photography. Photos are updated in alternate years and include details by variety and age of trees based on ground verification of the photos. In 1974, Texas began its citrus tree inventory program which is very similar to Florida's. Tree number estimates are based on aerial photography obtained every 2 years. Only those groves that show changes from the previous photos and new plantings are enumerated using personal interviews to determine age and varieties.

Tree inventory information in States other than California, Florida, and Texas is limited largely to special mail surveys at periodic intervals, usually every 5 years, when funds from State or industry sources are matched with Federal funds. These surveys utilize standard procedures and questionnaires. All States in a region are normally included so data can be summarized for regional totals. Surveys cover all known commercial growers (those with 100 or more trees of any one kind of fruit or vineyards with 500 or more vines). Information is based on complete enumeration of growers using mail inquiries with enumeration followup of nonrespondents.

Reliability

Accuracy of production forecasts for noncitrus fruit, citrus, and tree nuts varies significantly depending on the specific crop, State, and season. Reliability increases substantially where objective measurement surveys are conducted and if reliable tree inventory (bearing surface) information is available.

The goal is to forecast final production of a crop within 5 percent of the actual outcome at least two-thirds of the time. Each month of the growing and harvesting season, new information is collected and evaluated to ascertain the total production forecasts. The estimates, which are released around the 10th of each month, assume normal weather patterns, crop growth, and development, and typical harvest losses from the month of forecast until the end of harvest. Unusual weather (freezes, ideal growing conditions), insects, and economic or marketing decisions made by growers play a major role in the final production level.

Chapter 7

Livestock

Introduction

The SRS livestock estimating program focuses on cattle and calves, hogs and pigs, sheep and lambs, and goats. Reports cover inventory numbers, births, number on feed, wool and mohair production, slaughter, production, disposition, and income, and number of operations with each species (table 12). This comprehensive program developed from an annual estimate of livestock inventory inaugurated in 1866.

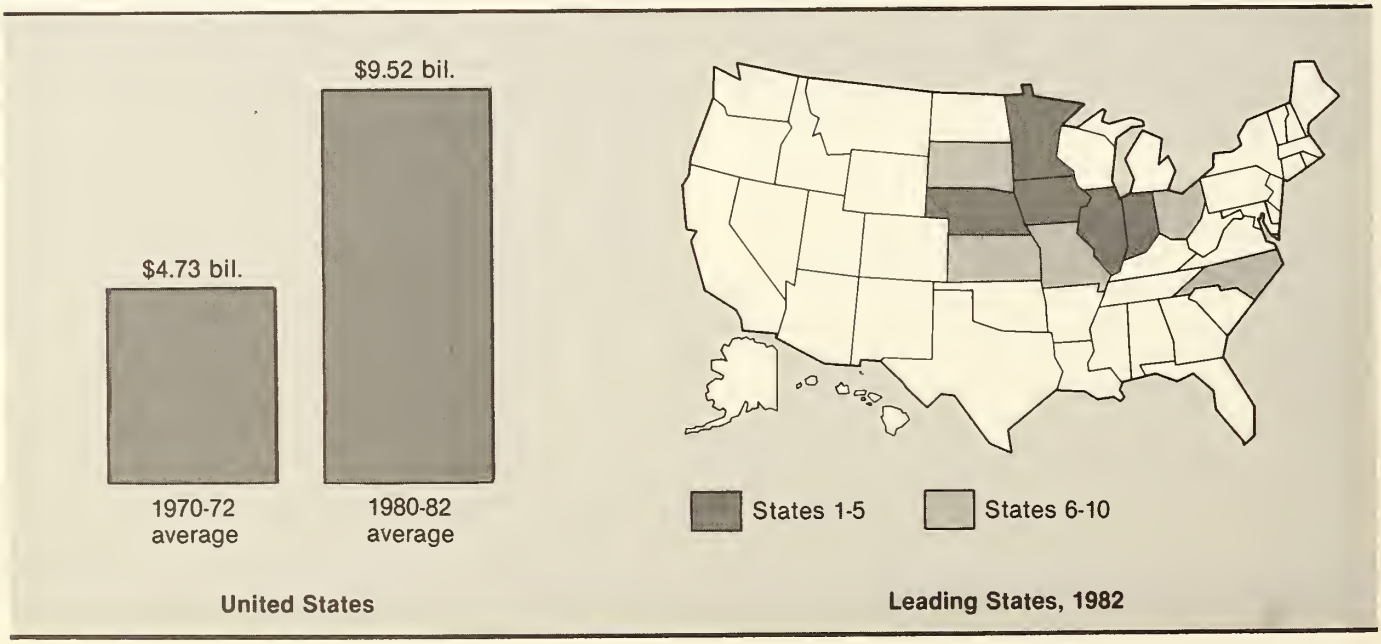
SRS has made many adjustments in survey techniques and estimating procedures in order to keep abreast of changes in agriculture, increased data needs, and improved sampling technology. For many years, surveys consisted of questionnaires mailed to a large number of informed individuals asking about livestock inventories, marketing weights, deaths and other losses, diseases, breeding and other practices, and conditions of ranges and pastures in their locality. Today's scientific probability surveys randomly select producers to be asked specific questions about the livestock on their farms and ranches.

General Methods

Improved methods for preparing indications and analyzing survey data have been implemented in recent years. Direct expansions of the estimated items from probability surveys have replaced the "identical" (C/C) percentage changes and average-per-farm indications used for preparing estimates from nonprobability mail surveys. The time-series chart (fig. 17) has replaced the dot or regression graph, enabling the statistician to review and interpret several indicators at one time rather than consider each indication on an individual chart.

The procedure used for estimating inventory numbers for each livestock species is basically the same. State statisticians analyze survey results, recommend estimates for their State, and transmit the data to SRS in Washington, D.C. State survey results are summarized nationally and by major regions or State groupings. The CRB members review the various data and establish national and regional estimates. Maximum use is made of survey data and other information available at the na-

Figure 16. **Value of Hog Production**



tional and major State grouping levels. Individual State recommendations are reviewed by CRB members and the national commodity statisticians and changed, if necessary, to make them total to the established national and regional estimates.

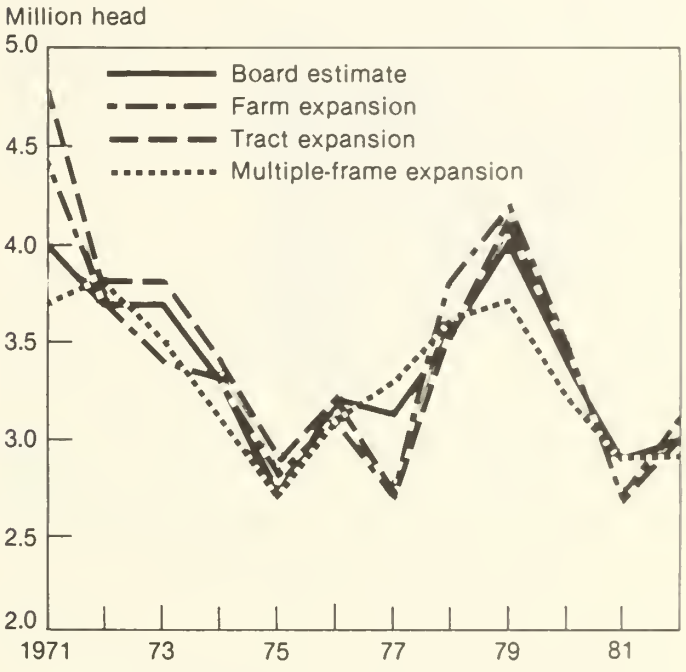
Survey direct expansions are used to establish the best current inventory estimates. Inventory data are considered the most reliable indications from sample surveys, since producers report numbers actually on their farms at the time of the survey. On the other hand, births, deaths, and farm slaughter are historical items of information that are subject to memory bias. A balance sheet and its components are also reviewed when the inventory numbers are established. Commercial slaughter is an important element of the balance sheet at the national level since its high degree of reliability is based on a near-actual count of animals slaughtered. Live U.S. imports and exports to other countries are also considered.

Subtracting the disposition components of the balance sheet from supply components should, theoretically, give the current inventory. However, each component of the balance sheet has varying degrees of possible estimation error. To be most useful as an indication of inventory, therefore, each component should be estimated on the basis of all available information. The supply components of the U.S. balance sheet are the beginning inventory, births, and imports (inshipments for State balance sheets). From this supply, the disposition components—commercial slaughter (marketings at State level), farm slaughter, deaths, and exports—are subtracted. The result is the indicated number on hand at the end of the period or year. An example of the cattle and calves balance sheet used in estimating the January 1, 1982, U.S. inventory is shown below.

Cattle and calves balance sheet—United States, 1981

Item	*Number*
	1,000 head
Supply:	
January 1, 1981, inventory	114,321
Calf crop	44,776
Imports	659
Total supply	159,756
Disposition:	
Commercial slaughter	37,752
Farm slaughter	398
Deaths	4,897
Exports	88
Total disposition	43,135
Indicated January 1, 1982, inventory (supply less disposition)	116,621
Estimated January 1, 1982, inventory	115,604
Difference (indicated less estimated)	1,017

Figure 17. **Example of a Time-Series Chart for a State's Cattle Inventory**



Check data, along with the original survey results, are used to review and revise preliminary inventory estimates if necessary. Check data include the number of animals slaughtered in commercial plants, inshipments, outshipments, brand inspection records (cattle), State livestock assessments, and, in a few States, the State farm census. U.S. Census of Agriculture figures available about every 5 years provide additional check data.

Hogs and Pigs

Four *Hogs and Pigs* reports are issued each year providing basic supply statistics for forecasting pork production (table 12). The reports relate to March 1, June 1, September 1, and December 1 and are issued between the 20th and 24th of those months. Basic data included in these reports are inventories on farms, numbers of sows farrowing, pig crop, and sow farrowing intentions for the following 2 quarters.

The December report provides estimates for 50 States and the U.S. total. Each of the three other reports provides separate estimates for 10 States that account for about 79 percent of the U.S. hog population. The June report also contains a combined estimate for the 40 other States and U.S. totals. (See fig. 18 for State groupings.)

Survey and Estimating Methods

Two types of surveys are used to collect data from producers required for making hog and pig estimates in the 48 conterminous States, probability multiple-frame surveys and probability area-frame surveys (table 13). In multiple-frame surveys, farm operators with land in the segments of the SRS area-frame, who are not accounted for on the list frames of hog producers, are surveyed each quarter to measure the incompleteness of the list frame.

Direct expansion of the items to be estimated are computed from the probability surveys. Expansions are computed for numbers of: total hogs and pigs, hogs and pigs kept for breeding, market hogs and pigs by weight

Table 12—**Calendar of livestock reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Cattle												
Inventory number and value of all cattle and calves and number on feed, Jan. 1; number of operations keeping cattle and milk cows	●											
July 1 inventory numbers and expected calf crop, United States; distribution of cattle operations and inventory by size groups, major States and United States							●					
Cattle on Feed												
Number on feed by classes and weight groups, placements, marketings, other disappearance, expected marketings, 13 States	●			●			●			●		
Number on feed, placements, marketings, and other disappearance, 7 States	●	●	●	●	●	●	●	●	●	●	●	●
Hogs and Pigs												
Quarterly for 10 States: inventory and number by classes; farrowings and pig crops, preceding 6 months; indicated farrowing next 6 months			●			●			●			●
For 50 States: Dec. 1 inventory and value, actual and indicated farrowings, number of hog operations; operations and inventory by size groups												●
Sheep and Goats												
Inventory, value, number by classes, number of sheep operations, United States, Jan. 1; goat estimates for Texas only	●											
Wool and Mohair												
Number of sheep shorn, wool production, price, and value by State; number of goats clipped, mohair production and value, Texas			●									
Livestock Slaughter												
Number of head and live weight slaughtered in commercial plants, by State; red meat and lard production, United States	●	●	●	●	●	●	●	●	●	●	●	●
Livestock Slaughter Annual Summary			●									
Meat Animals, Production, Disposition, and Income				●								

Table 13—**Hogs and pig surveys**

Survey date and areas[1]	Survey basis for estimates	Percentage of all U.S. hogs and pigs, December 1, 1982
		Percent
December 1:		
10 quarterly States	Multiple frame and area frame	79
13 other States	Multiple frame and area frame	16
27 other States[2]	Area frame	5
March 1:		
10 quarterly States	Multiple frame	79
June 1:		
10 quarterly States	Multiple frame and area frame	79
40 other States[3]	Area frame	21
September 1:		
10 quarterly States	Multiple frame	79

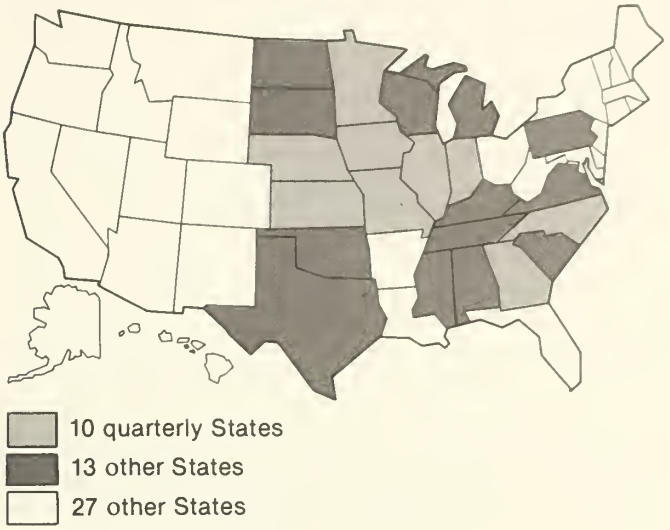
[1] See fig. 18 for States in each group.
[2] Alaska conducts a nonprobability mail survey and Hawaii conducts a probability mail survey.
[3] Area-frame surveys not conducted in Alaska and Hawaii.

groups, sows farrowed, pigs on hand and pigs already sold from farrowings within the past 3 months or 6 months, sows intended to farrow, hogs and pigs slaughtered on farms, hogs and pigs custom slaughtered off the farm, and hogs and pigs above weaning age that died.

Forming the Estimates

In making the estimates, probability expansions are compared with historical survey and CRB levels and sampling errors associated with each current indication are reviewed. Probability area-frame expansions of total U.S. hog and pig inventories have a sampling error of 3 to 4 percent. The sampling error for the 10 States in the quarterly multiple-frame survey is less than 2.5 percent for the 10-State total and usually ranges from 3 to 8 percent for the individual States.

Figure 18. **State Groups for Hogs and Pigs Estimates**



Inventory

Hogs and Pigs reports provide inventory estimates as of the first of March, June, September, and December. The reports indicate numbers of all hogs and pigs on farms, distinguishing those kept for breeding and those intended for market. Hogs and pigs for market are divided into four weight groups: under 60 pounds, 60-119 pounds, 120-179 pounds, and 180 pounds and over.

In estimating hog and pig numbers, SRS uses survey direct expansions to establish the best current inventory estimates of all hogs and pigs. Inventory data are considered the most reliable indication from sample surveys since hog producers are asked to report animals on their farms at the time of the survey. In setting the inventory estimates, the CRB also constructs a balance sheet using survey-based estimates on births and deaths, and check data on slaughter, imports, and exports, to provide a check on current survey inventory estimates.

The inventory estimate for all hogs and pigs, once established, is separated into estimates of hogs for breeding and hogs for market. This separation is made on the basis of survey expansions for the two classifications and the percentage of each class reported in the survey. The number of market hogs is further separated into the four weight groups, following the same procedure. End-of-year inventory values of animals are based upon an estimated average value per head for breeding and market animals.

Pig Crop

The pig crop is defined as the number of pigs from farrowings during the estimating period that are still on the farm at the end of the period, died after weaning, or were sold or slaughtered during the period. Deaths of pigs prior to weaning are not estimated in the pig crop. For example, in 10 States, the pig crop for March through May would be the number of pigs born March through May that were on hand June 1, had died since weaning, or had been sold or slaughtered. The number of sows farrowing and pig crops are estimated for each quarter of the year in the 10 States included in the quarterly report. In all other States, sows farrowed and pig crops are estimated only for the two 6-month periods: December through May and June through November.

The June and December *Hogs and Pigs* reports provide estimates of the number of sows actually farrowing during the preceding 6-month period and the number of sows expected to farrow during the following 6 months. Actual farrowings are further divided into two 3-month periods. For the 10 States that estimate quarterly, all four *Hogs and Pigs* reports provide actual number of sows farrowing in the previous quarter and expected farrowings for the following two quarters.

The direct expansion of pig crop from the survey—divided by the expanded number of sows farrowed—provides the indication for estimated average number of pigs per litter. Primary emphasis is on estimating the total pig crop with concurrent review of the number of sows farrowing and average pigs-per-litter survey indications.

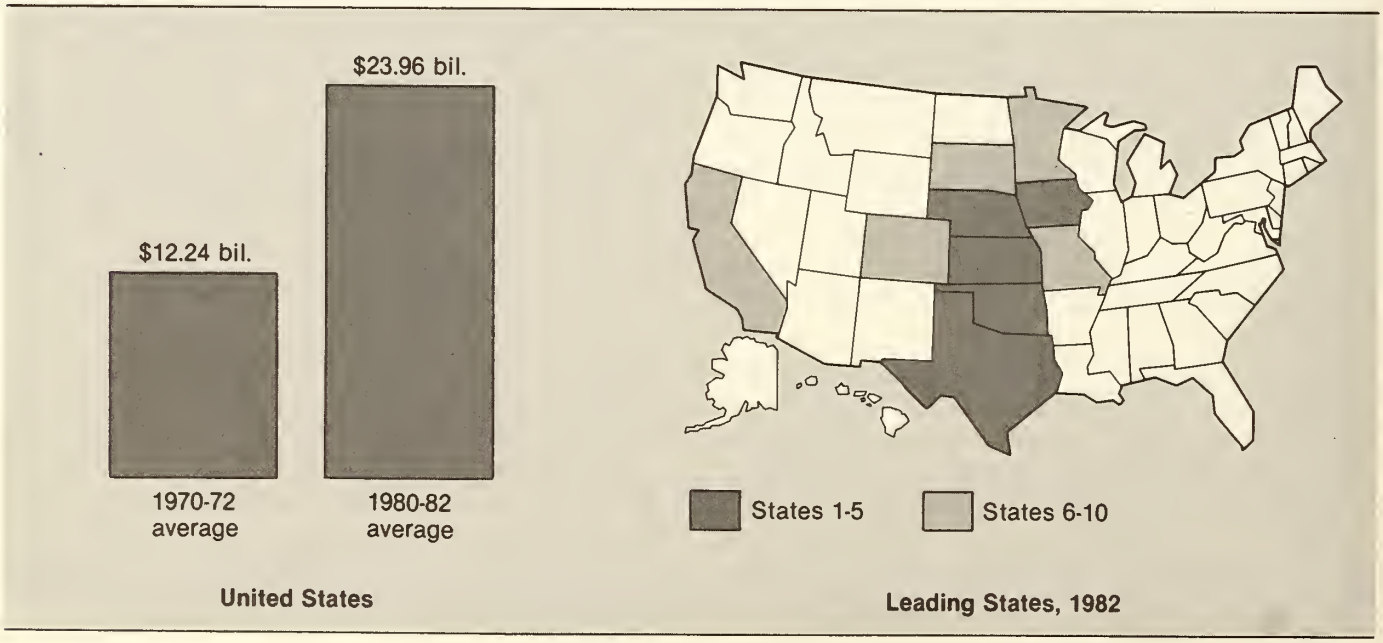
Revisions

Revisions of estimates are published in the next *Hogs and Pigs* report which includes estimates for the specific group of States for which revisions are required. All estimates for the previous year and current year are again subject to review and revision each December. Revisions are based primarily on data that become available following the initial estimates, such as slaughter or marketing data. The initial survey data are also reevaluated in light of any revisions suggested by the other data. All estimates are subject to further review and revision at 5-year intervals when U.S. Census of Agriculture data become available.

Cattle and Calves

Two reports are issued annually on cattle and calf inventories and calf births (table 12). A report issued in late January provides estimates of cattle and calf inventories as of January 1 and number of calves born during the previous year. A second report issued in late July provides July 1 cattle and calf inventories and number of calves born and expected to be born during the year. The January report includes estimates for all States and the United States while the July report provides only U.S. totals.

Figure 19. **Value of Cattle Production**



Survey and Estimating Methods

Direct expansions for all cattle and calves, cattle and calves by classes, calves born, farm slaughter, and deaths are computed from the probability area-frame and multiple-frame surveys in the 48 conterminous States (table 14 and fig. 20). Farm slaughter and deaths during the year are collected only during year-end surveys and are used for preparing a balance sheet and production, disposition, and income estimates. A mail survey in Alaska and Hawaii with nonresponse followup interviews provides indications for cattle estimates in those States. Area-frame surveys are not conducted.

A review of survey indications, including a comparison of current survey expansions and indications with historical survey and CRB levels, precedes the setting of estimates. The sampling error associated with each estimate from the current probability surveys is also reviewed. Total cattle and calf inventory expansions from the probability area-frame surveys have a coefficient of variation (sampling error) of about 2 percent at the U.S. level. The total inventory sampling error usually ranges from 2 to 5 percent for individual States conducting multiple-frame cattle surveys.

Table 14—**Cattle and calf surveys**

Survey date and area [1]	Survey basis for estimates	Percentage of all U.S. cattle and calves, January 1, 1983
		Percent
January 1:		
34 States	Multiple frame and area frame	95
16 States [2]	Area frame	5
July 1:		
50 States [3]	Area frame	100

[1] See fig. 20 for States used in each group.
[2] Mail survey conducted in Alaska and Hawaii in lieu of area-frame survey.
[3] Survey not conducted in Alaska and Hawaii. July estimate includes an allowance for these States based on trend, amounting to about 0.2 percent of U.S total.

Inventory

The cattle inventory estimates as of January 1 and July 1 cover all cattle and calves, which are separated into eight classifications by sex and weight. The eight classifications include all cows that have calved (separated into beef cows and milk cows); heifers 500 pounds and over (divided into beef cow replacements, milk cow replacements, and other heifers); steers 500 pounds and over; bulls 500 pounds and over; and heifers, steers, and bulls under 500 pounds.

The first step prior to estimating various classes of cattle is to establish the total cattle and calf inventory estimate using primarily current survey data. The balance sheet at the U.S. level and its components, particularly calf crop, are also reviewed when establishing the total inventory. Cattle charts similar to fig. 17, plotting cattle and calf survey data and estimates, are used for the total inventory estimates.

The estimate of all cows and heifers that have calved is established next, using survey expansions similar to those used for setting the all-cattle-and-calf inventory. The survey-reported relationship of all cows to the total cattle and calf inventory is also considered. Estimates for the other classes are based on survey expansions and the survey-reported number for each class as a percentage of the total reported number.

Calf Crop

The primary survey indications used to estimate the calf crop are expansions from the probability area-frame and multiple-frame surveys and the survey ratio of calves born and expected to be born to all cows times the estimated number of all cows as of the survey date.

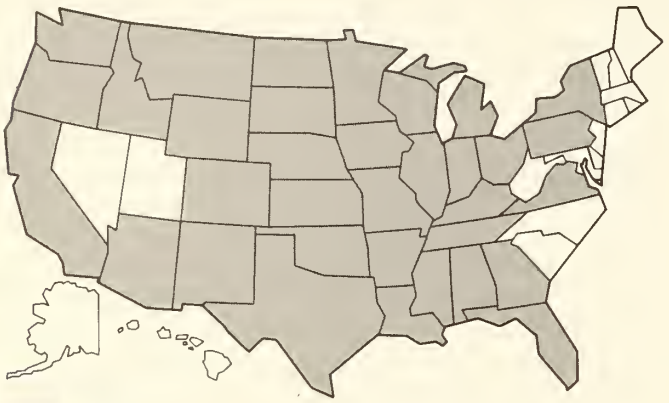
Revisions

All estimates for the year are reviewed at the end of the year following release. The review considers later data such as State farm census, assessments, and balance sheet components. Any necessary revisions are published in the following year report along with current January 1 estimates.

Cattle on Feed

Cattle and calves on feed are defined as those being fattened on full feed of grain and other concentrates for slaughter market, and expected to produce a carcass that will grade good or better. Estimates are made monthly for 7 States (Arizona, California, Colorado, Iowa, Kansas, Nebraska, and Texas) representing about 70 percent of the cattle on feed in the United States. Quarterly estimates are made for 13 States (the 7 monthly States plus Idaho, Illinois, Minnesota, Okla-

Figure 20. **State Groups for Cattle and Calf Surveys**



homa, South Dakota, and Washington) representing about 85 percent of the U.S. number. A 50-State estimate is made on January 1.

Types of Estimates

Estimates prepared monthly for the seven States include the number of cattle and calves on feed on the first of each month, the number of cattle and calves placed in feedlots during the preceding month, the number of cattle marketed from feedlots for slaughter during the preceding month, and other disappearance, such as deaths or movement to pasture or other feedlots, during the preceding month.

Estimates prepared quarterly as of the first of January, April, July, and October for the 13 States include:

- Total number of cattle and calves in feedlots being fattened for slaughter as of the first day of each quarter.
- Total number separated into three kinds: steers and steer calves, heifers and heifer calves, and cows and others.
- Total number by kinds classified by five weight groups: under 500 pounds, 500-699 pounds, 700-899 pounds, 900-1,099 pounds, and 1,100 pounds and over.
- Number of cattle and calves placed in feedlots during the preceding 3 months.
- Number of cattle marketed from feedlots for slaughter during the preceding 3 months.
- Other disappearance from feedlots during the preceding 3 months (deaths, movements to pasture, and movements to other feedlots).
- Expected marketings from feedlots for slaughter during the next 3 months.

Estimates in the 37 States reporting annually are limited to an inventory total as of January 1.

The January *Cattle on Feed* report also estimates the number of cattle feedlots and number of fed cattle marketed during the preceding year by size of feedlot for the 13 quarterly States.

Survey and Estimating Methods

Estimates of number of cattle on feed are based on reports from cattle feeders obtained by mail, telephone, and personal enumeration. Each SSO maintains as complete a list as possible of cattle feedlots, which are stratified by size for survey purposes. Each SSO receives reports from virtually all large cattle feeders by mail or interview; estimates for the smaller feeders are based on mail reports from a sample of the feeders.

Cattle feeders are stratified by operation size for survey summarization purposes. The stratification is usually based on the number of cattle on feed as of January 1, but some SSO's use feedlot capacity for larger feedlots and historical inventory numbers for smaller feeders. Indications from the monthly and quarterly surveys used to prepare estimates of number of cattle on feed include direct expansions, ratio-to-capacity expansions, ratio-to-base expansions, C/C identical expansion from previous quarter, C/C identical expansion from previous month (only for States reporting monthly), and ratios of selected items to reported inventories.

In the 37 States preparing annual estimates only, cattle-on-feed data are collected as part of a probability area-frame survey and the January 1 cattle and calf inventory survey. The indications used in these States include direct expansions and the reported number of cattle on feed in the survey as a percentage of the total reported cattle and calf inventory times the estimated total cattle and calf inventory.

A thorough review of the survey indications precedes the setting of estimates. This review includes a stratum-by-stratum review of the current indications with previous surveys, as well as a comparison of the State and regional expansions and indications with historical survey and CRB levels.

Inventory

The inventory number of cattle and calves on feed is set first, based on the survey expansions. For quarterly reports, this number is then separated into kinds on feed—steers and steer calves, heifers and heifer calves, and cows and others—based on the comparable reported number of each kind as a percentage of total reported cattle and calves on feed. The total number of steers and steer calves and heifers and heifer calves on feed is further divided into weight groups, following the same procedure used for estimating the kinds on feed.

Placements and Marketings

Monthly and quarterly placements and marketings of fed cattle are estimated, using primarily the survey ratio of the reported number placed, marketed, or expected to be marketed during the period to the reported number of cattle and calves on feed times the estimated number on feed.

The following formula illustrates the procedures used in estimating for placements and marketings:

Let:

C = estimated cattle on feed inventory,

c = survey-reported cattle on feed,

P_m = estimated monthly placements,

p_m = survey-reported monthly placements,

P_q = estimated quarterly placements,

p_q = survey-reported quarterly estimates,

M_m = estimated monthly marketings,

m_m = survey-reported monthly marketings,

M_q = estimated quarterly marketings,

m_q = survey-reported quarterly marketings.

Then:

$$P_m = \frac{p_m}{c} \cdot C \text{ and } P_q = \frac{p_q}{c} \cdot C$$

$$M_m = \frac{m_m}{c} \cdot C \text{ and } M_q = \frac{m_q}{c} \cdot C$$

Check data, such as shipments of feeder cattle into each State, are also used in estimating placements. Steer and heifer slaughter provides supplementary data for estimating actual marketings.

A useful indication for estimating expected marketings during the following 3 months is the estimated number on feed in selected heavy weight groups that normally would be marketed during those months. This number is interpreted by use of regression charts that show the historical relationships of the number on feed in the heavy weight groups to estimated actual marketings for the period.

Cattle Feedlots and Fed Marketings by Size of Feedlot

The estimates of the number of cattle feedlots and fed cattle marketings by size of feedlots are published each January, based primarily on data collected from monthly and quarterly surveys.

The estimated feedlots with a capacity of 1,000 head or more represent the number of lots of that size that operated any time during the year. Lots vacant during the entire year are not counted. On the other hand, the estimated lots under 1,000 head are those feeding cattle at the end of the year. The estimate of cattle marketed from lots with a capacity of 1,000 head or more is based on an almost complete enumeration. SSO's prepare estimates for the few large lots that fail to provide the requested data; hence, published data cover the entire universe. The number of cattle marketed from lots with less than 1,000-head capacity is largely derived from the estimated total number marketed minus the number marketed from lots with capacity of 1,000 head or more.

Revisions

Estimates of cattle on feed are subject to review and revision in subsequent reports during the year. Revisions are based primarily on slaughter and shipment data and on reports from feedlots not available to SRS when preparing the initial estimates.

Sheep and Lambs

January 1 sheep and lamb inventories by classes, and estimates of the previous year's lamb crop by States and for the Nation, are published in late January in the *Sheep and Goats* report. Estimates of the number of sheep and lambs shorn and wool production for all States during the preceding year are published in March.

Survey and Estimating Methods

A probability list sample and data collected by mail survey, with telephone and personal interviews for nonresponse, provide basic information for estimating the January 1 sheep and lamb inventory, lamb crop, number of sheep shorn, wool production, deaths, and farm slaughter during the previous year.

For survey purposes, each State maintains as complete a list as possible of sheep producers, including a measure of size for each operation. The primary source of information for developing and updating these lists is the file of applications to ASCS by sheep producers for wool incentive payments. Sheep producers on the list are stratified by size of operation, and sample names are selected by stratum for survey purposes. The larger operations were sampled at higher rates. Questionnaires are mailed to all selected producers, with followup personal or telephone contacts of producers not responding to the mail inquiry.

Direct expansions and expansions based on the ratio to the control variable used to stratify the list are computed from the probability list surveys for the following items: total sheep and lambs, total stock sheep and lambs, sheep and lambs on feed, ewes 1 year and older, and lamb crop. Ratios of selected items to the total inventory or major class are computed by stratum to provide survey indications for other inventory classes, deaths, and farm slaughter.

A thorough review of the survey indications precedes the establishment of estimates. This review includes a stratum-by-stratum comparison of the current indications with previous surveys, as well as a comparison of the State and regional expansions and indications with historical survey and CRB levels.

Inventory

The sheep and lamb inventory as of January 1 includes estimates of the number of all sheep and lambs, sheep and lambs on feed, and stock sheep and lambs. Stock sheep and lambs are classed as: ewe lambs, wether and ram lambs, ewes 1 year old and older, and rams and wethers 1 year old and older. The inventory excludes new-crop lambs (those born after September 30). Separate estimates are provided for the new-crop lambs on hand January 1.

All stock sheep and lamb inventories are established by procedures similar to those used for estimating cattle and calves. Current survey expansions are the primary basis with a check provided by review of a U.S. balance sheet. Once the total stock sheep and lamb inventory is set, it is divided into the four classes. These class estimates are based largely on the proportions of total stock sheep and lambs indicated by the survey expansions.

Lamb Crop

The primary indications used to estimate lamb crop are the direct expansions from the surveys and the survey ratio of lamb crop as a percentage of ewes 1 year old or older. The annual lamb crop includes lambs born between October 1 and September 30 in the Native States (those east of the Rockies except Texas) and lambs docked or branded in the Western States.

Sheep Shorn and Wool Production

For wool production estimates, producers are asked to report the number of sheep and lambs shorn on their farms or ranches and the total pounds of wool produced. The average weight per fleece is derived from this information. The estimated number of sheep shorn is based on the expanded numbers from the January 1 survey and the relationship of the number shorn to the total January 1 inventory. Shearing of fed sheep and lambs is estimated separately from stock sheep in States where this is an important practice. In these States, the two estimates are added to obtain total number of sheep and lambs shorn and total wool production.

Data from applications filed in connection with the ASCS wool incentive payment program, when available, are also used in preparing the March estimate of number of sheep and lambs shorn and wool production for the previous year. Tabulations from this program provide data on wool production and the number of sheep and lambs shorn by year of clip.

Revisions

The January 1 inventory and lamb crop estimates are subject to review and revision the following January. Revisions are based on assessment, State farm census, and marketing data which became available after the original estimates were made. Estimates of the number of sheep shorn and wool production are subject to revision in March, 2 years after actual shearing. Data from applications filed for wool incentive payments for the year when payments are made are the primary basis for revising estimates of number shorn and wool production. Receipts at wool warehouses provide supplemental information.

Goats and Mohair

Goat estimates are made only for Texas and include January 1 inventory numbers of goats on farms and ranches, annual number of goats clipped, and mohair production. The January 1 goat inventory is published with sheep inventory estimates in late January. The number of goats clipped and mohair production during the previous year are published with wool production each March. Each estimate is based on direct expansion from the multiple-frame survey conducted by the Texas SSO. Additional information for mohair production estimates comes from warehouse receipts and tabulations from the mohair incentive payment program.

Livestock Slaughter

Livestock slaughter statistics consist of two major series, commercial slaughter and slaughter done on farms and ranches where livestock are produced.

Commercial Slaughter

Estimates of commercial slaughter include slaughter in federally inspected plants and plants not under Federal inspection, but exclude slaughter on farms. Federally inspected slaughter refers to slaughter actually completed under Federal inspection. Nonfederally inspected slaughter includes that completed under State inspection programs and in "custom only exempt" plants. Meat from custom-only exempt establishments cannot be sold commercially and consists largely of slaughter done for farm and ranch operators.

State and national commercial slaughter estimates of cattle, calves (including vealers), sheep and lambs, and hogs cover number of head slaughtered, their average live weight, and total live weight. Total pounds of red meat are also estimated at the State and national levels. National data reflect federally inspected slaughter of cattle classified as steers, heifers, cows, and bulls and stags. Hogs are classified as barrows and gilts, sows, and stags and boars. Sheep are classified either as mature sheep or lambs and yearlings. The number of head in each class and its percentage of the species total are estimated. In addition to the above items, the average dressed weight is provided for each of the cattle classes, along with calves and vealers, hogs, and sheep and lambs.

The *Livestock Slaughter* report is issued near the end of each month and relates to slaughter during the preceding month.

Collection of Data for Federally Inspected Slaughter

The number of head slaughtered under Federal inspection is obtained from reports prepared by the meat inspectors under the supervision of USDA's Food Safety and Inspection Service (FSIS). Meat inspectors record the number of head slaughtered daily of each species on a weekly form. Thus, a complete enumeration is obtained for the number of head slaughtered.

Weekly data are also provided for live weight and dressed weight for each species along with the comparable number of head slaughtered. The weekly form is mailed to SRS in Washington, D.C., on the last working day of each week.

Weekly totals are generated from the daily counts, and supplied to the Livestock Market News Branch of AMS in Washington, D.C., for weekly publication. The daily and weekly summaries provide the total monthly number slaughtered in all federally inspected plants by State and for the Nation. Daily totals are used to adjust monthly slaughter for weeks that begin and end in different months.

The proportion of total commercial slaughter that is federally inspected has increased each year. Slaughter in federally inspected plants in 1982 accounted for 94.6 percent of the cattle, 90.4 percent of the calves, 96.5 percent of the hogs, and 97.3 percent of the sheep and lambs.

Collection of Data for Nonfederally Inspected Slaughter

Data for nonfederally inspected slaughter are supplied from State inspection records as well as from mail surveys conducted by SSO's. Where complete State inspection data are not available, or where there are custom-exempt establishments, the SSO's conduct monthly surveys. For most States, the nonfederally inspected slaughter estimate is based on complete or nearly complete enumerations. Nonfederally inspected plants are stratified into those slaughtering 2 million pounds or more per year, those slaughtering between 300,000 pounds and 2 million pounds, and those slaughtering less than 300,000 pounds annually. Large plants are usually contacted in person or by phone if a response is not received by mail. Several indications are employed for estimating nonfederally inspected slaughter by plants not reporting, including a ratio-to-base expansion, a month-to-month identical expansion, and an average per-plant expansion. An indication of average live weight is computed for each species and is the basis for the estimated live weight for nonfederally inspected slaughter.

The SSO's recommend estimates of nonfederally inspected slaughter and average live weight. These estimates are sent to Washington, D.C., for review and consolidation into regional and national totals. State estimates of nonfederally inspected slaughter are then combined with federally inspected slaughter for the estimate of total commercial slaughter for each State and the Nation.

Red Meat Production

Red meat production is computed from commercial slaughter on a national level for beef, pork, veal, lamb, and mutton. For beef, veal, lamb, and mutton, meat production is computed, using a dressing percentage applied to total live weight after an allowance is made for the number of head condemned. Pork production is computed in a similar manner except that the dressing percentage is reduced to adjust for lard and pork fat rendered per head to arrive at a net dressing percentage. Meat production for each species is then added to obtain a total of all red meat, with lard production estimated separately.

Lard Production

Estimates for production of lard are established separately from the estimate of red meat production. The quantities of lard rendered, lard refined, pork fat rendered, and pork fat refined in federally inspected livestock slaughter and meat-processing plants are recorded by the Meat Inspection Division of FSIS. Estimates of lard production from slaughter reported by the nonfederally inspected slaughter plants are added to federally inspected lard to arrive at total commercial lard production.

Farm Slaughter

Livestock farm operators are surveyed annually to obtain data on the number of each species slaughtered on their farms during the past year. This becomes the basis for the farm slaughter estimate, which is added to commercial livestock slaughter to obtain total slaughter and is published in the annual slaughter report in March. Primary indications are direct expansions from the December enumerative survey and the multiple-frame survey.

Production, Disposition, and Income for Meat Animals

State and national estimates of the production, disposition, and income from meat animals—cattle and calves, sheep and lambs, and hogs—are published annually. Estimates for each species include number of pounds produced and sold, value of production, cash receipts, value of home consumption, gross income, and number of deaths and number of animals slaughtered on farms.

Estimating these components by States is a detailed process because of the way livestock are raised and marketed. Livestock production depends on births, deaths, and increases in weight of the animals. Disposition of the animals through slaughter and deaths is continuous, with varied ages and weights at slaughter, and various class proportions from year to year.

Furthermore, the entire livestock production process is not always completed within the locality where the animals were born. There is an extensive movement between States of unfinished animals to be grown out or finished.

The following data components are involved in the computations for this report:

- Livestock inventories as of January 1 for cattle and sheep, and December 1 for hogs;

- Births of calves, lambs, and pigs during the year;
- Average inventory live weights;
- Deaths and farm slaughter;
- Numbers and average weights of marketings and inshipments obtained from records of State health inspection, stockyards, and packers; and
- Average monthly prices received by farmers.

Estimates of the annual volume of livestock production in each State, by species, are developed by three separate operations. The first involves beginning-of-year inventories. The number for each species is divided into groups based on sex and either weight, age, or purpose. Average live weight per head for each group is estimated and multiplied by the number of head at the beginning of the inventory period to give the total inventory weight. This is also done at the end of the year and the difference between the two totals is the yearly increase or decrease in inventory live weight.

The next operation is to determine the items of increase and decrease responsible for changes in inventory numbers during the year. Beginning inventory plus births and inshipments minus marketings, farm slaughter, and deaths equals the ending inventory. Estimates of these components are based on surveys and available records.

The third step in estimating annual livestock production is to determine the total pounds of live weight involved in all marketings. For each species series (the number of animals shipped in, marketed, slaughtered locally, and slaughtered on farms), there is a corresponding series of estimated live weights by States. The product of species number times average live weight yields total pounds.

The total weight of animals marketed, slaughtered locally, and slaughtered on farms is obtained for each species and the total weight of unfinished animals shipped in is subtracted. The resulting difference is adjusted by the difference obtained from the beginning-of-year and end-of-year inventory live-weight aggregates. The resulting amount represents total pounds produced.

Value is the product of production and the weighted average price per hundredweight. The average price is obtained by weighting monthly prices received by quantities marketed each month.

The procedure used to estimate farm production of meat animals permits computation of cash receipts and gross income from meat animals. Cash receipts are derived by multiplying estimated marketings and slaughter (in pounds) by the season-average prices received by farmers. Gross income is the sum of cash receipts and value of farm and custom slaughter that was consumed on the farms where produced.

Livestock Operations by Species and Size

Estimates of the number of livestock operations by species—those with cattle, milk cows, hogs, and sheep—are published annually. A species operation is defined as having one or more of the species on hand during the year. Indications of the number of livestock operations by species come primarily from the probability multiple-frame and area-frame surveys. Counts obtained in conjunction with crop surveys or State farm censuses in some States provide additional indications for these estimates.

For cattle and hogs, survey indications are further classified based on the number of head in the current inventory. These indications are used to estimate the proportion of operations and inventory in each of the size groups. Hogs and pigs size groups are 1-99 head, 100-499 head, and 500 or more head. Percentages are estimated for each of the 10 quarterly States, all other States as a group, and the United States in the December 1 *Hogs and Pigs* report. Cattle and calf size groups are 1-49 head, 50-99 head, 100-499 head, and 500 or more head. Percentages for 28 major States are published in the July *Cattle* report along with combined totals for the other States and U.S. averages. Milk cow size groups are 1-29 head, 30-49 head, 50-99 head, and 100 or more head. Percentages for 33 States are estimated separately along with combined totals for the other States and U.S. averages in the July *Cattle* report.

Chapter 8

Dairy

Introduction

An annual report of the production of manufactured dairy products in 1917 opened USDA's statistical work in dairying. The series on milk production, utilization, and income from dairying were initiated in 1924. Although current comprehensive monthly and annual surveys now provide added coverage, a strong demand continues for more information, especially statistics, relating to new dairy products.

Currently, SRS provides data on farm production and disposition of milk, utilization of milk supplies, manufactured dairy products, and milk prices. The four categories involve different basic sources of survey data, survey methods, and estimating procedures.

Most of the survey data needed for estimating milk production and disposition are provided by dairy farmers. Information on the utilization of milk supplies and on milk prices is furnished mainly by milk and dairy product processing plants.

All survey data are collected, summarized, and analyzed in SSO's, where the State statisticians prepare reports and submit them to the CRB in Washington, D.C., for review and inclusion in national reports. Official State and national estimates are set in Washington and official reports issued by the CRB on published release dates (table 15).

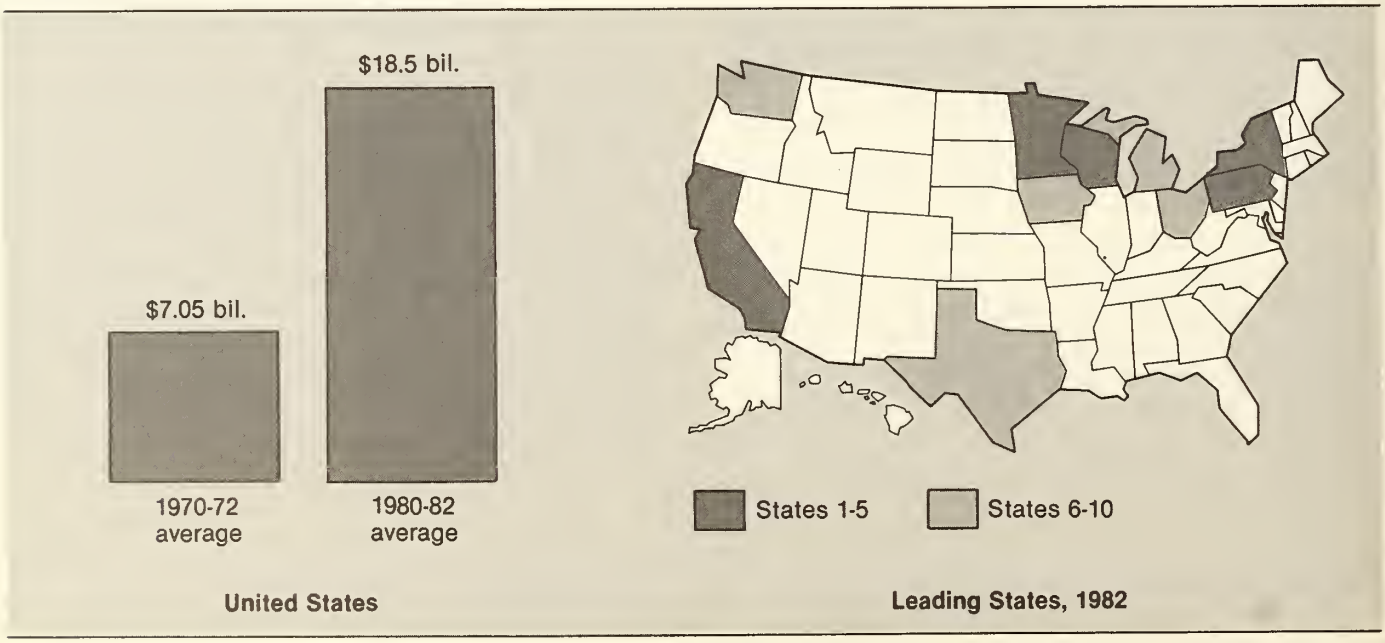
Milk Cows and Milk Production

Monthly surveys of milk producers are conducted in 33 major milk-producing States to estimate the number of milk cows and amount of milk produced. These States account for approximately 95 percent of U.S. milk production. Milk production estimates based on quarterly surveys are made in the 17 remaining States (fig. 22).

Preliminary estimates of milk production, production per cow, and the number of milk cows for the 33 States and the United States are published in the monthly *Milk Production* report.

For each monthly report, an aggregate estimate is made for the 17 States reporting quarterly, based on trends in

Figure 21. **Value of Milk Production**



the 33 States that report monthly. In addition, the January, April, July, and October reports contain estimates of number of milk cows and quarterly milk production for each of the 50 States. The February issue provides revised monthly production estimates for the preceding 2 years for the major 33 States and revised quarterly production estimates for the 17 States, and estimates of the annual average number of milk cows, annual production per cow, and annual milk production for all States.

Number of Milk Cows

Estimates of the number of milk cows are based on indications from probability area-frame and multiple-frame surveys, and nonprobability mail surveys. These include probability survey expansions for total cattle and calf inventories on January 1 and July 1. Milk cows that have calved constitute one of the eight classes of cattle and calves estimated from these surveys.

In June and December, area-frame enumerative surveys in the 48 conterminous States provide indications of number of milk cows that have calved. The January 1 multiple-frame cattle survey with extensive use of list-frame sampling provides milk cow indications in all major cattle States. All States conduct nonprobability mail surveys monthly or quarterly according to their frequency in the estimating program. Although the nonprobability surveys depend primarily on mail response, nonresponse followup by telephone is increasingly used for large dairy operations.

Each January, probability survey expansions are used to estimate milk cow numbers for each State. Probability survey-based estimates are made for the United States on July 1. These inventory estimates become benchmarks for the monthly and quarterly milk cow estimates.

Monthly milk production surveys in the 33 major States and quarterly milk production surveys in the 17 States are nonprobability mail surveys that reflect the change in milk cow numbers between the major January 1 and July 1 cattle inventory surveys and also provide data on milk produced per cow. Each month, reports are received from about 2 percent of the Nation's milk cow farms that account for 5 percent of the milk cow population. Individual reports are summarized by size groups to reduce sample variability. The number of groups may vary by State, but three or four usually suffice. The basis for this sampling stratification is the number of milk cows in the herd, including dry cows.

Three indications of milk cow numbers are obtained from the surveys:

- *Ratio-per-Farm Expansion.* This indication is derived by multiplying the average number of milk cows per farm reported in each stratum by the estimated number of milk cow farms for that stratum. Individual stratum expansions are added to a State total.
- *Identical Expansion.* Current survey reports are matched with reports from the same farm for

Table 15—**Calendar of dairy reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Milk Production												
Number of milk cows, production per cow, and total milk production, 33 major States and United States	●	●	●	●	●	●	●	●	●	●	●	●
Milk production, all States	●			●			●			●		
Revised milk cow numbers and production, previous year		●										
Inventory and operations by size groups							●					
Quantity and value of grain fed	●			●			●			●		
Milk Production, Disposition, and Income					●							
Dairy Products												
Production of butter; cheese; frozen products; evaporated, condensed, and dry milk; whey products; selected States and United States	●	●	●	●	●	●	●	●	●	●	●	
Dairy Products Annual Summary					●							

the previous month or quarter. After "identical" reports have been tabulated by strata, the percentage change in number of milk cows for each stratum is multiplied by the estimated number of milk cows for the previous month or quarter. The sum of these stratum expansions is an indication of the current number of milk cows.

- *Ratio-to-Base Expansion.* As in the identical expansion, current survey reports are matched with corresponding reports from a base period. January 1 is the base period because the large-scale cattle inventory survey conducted by each State on January 1 provides the most precise estimates of milk cows by strata. The indicated change from the January 1 base in each stratum is multiplied by the estimated number of cows in each stratum on January 1. The sum of these stratum expansions is an indication of milk cow numbers for the current month or quarter.

The ratio-per-farm, identical, and ratio-to-base expansions are plotted on a time-series chart (see fig. 23). SSO's analyze and interpret these indications to make monthly or quarterly estimates of the number of milk cows. In Washington, D.C., the recommended State estimates are analyzed, national estimates are set, and State-level estimates are finalized.

Figure 22. **State Groups for Milk Estimates**

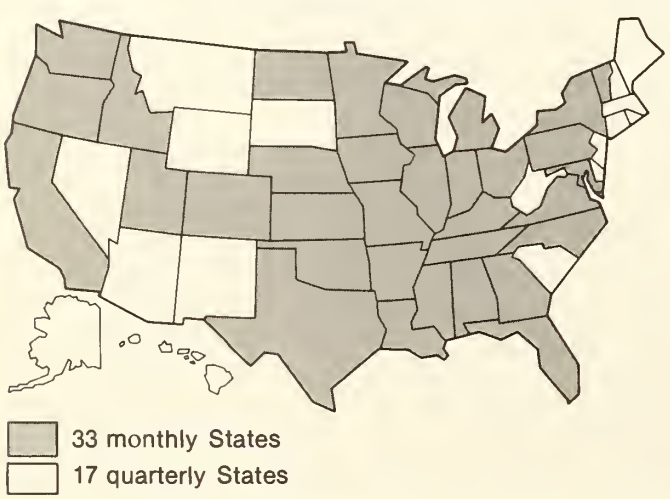


Table 16—**Indicated rate per cow**

Monthly States				
January 1 reported daily rate per cow	February 1 reported daily rate per cow	Average of 2 rates	Days in January	Indicated monthly rate per cow
33.0 lbs.	34.0 lbs.	33.5 lbs. × 31		= 1,038 lbs.
Quarterly States				
January 1 reported daily rate per cow	April 1 reported daily rate per cow	Average of 2 rates	Days in Quarter	Indicated quarterly rate per cow
34.0 lbs.	37.8 lbs.	35.9 lbs. × 90		= 3,231 lbs.

Milk Production per Cow

Milk production in each State follows a seasonal pattern which reflects the proportion of cows in milk, pasture conditions, feeding practices, and weather conditions. In order to estimate seasonal variations, monthly indications of production per cow are obtained throughout the year in the major milk-producing States.

Survey indications of milk production per cow are derived from producers' responses to questions about all milk cows and milk produced on their farms the preceding day. The milk produced divided by the number of milk cows gives the indicated rate of production per cow in each size stratum. These rates are weighted by the estimated number of milk cows in each stratum to determine an average daily rate for the State.

To estimate production per cow in all States, the weighted first-of-the-month daily rate from the current survey and previous survey are combined to determine an average daily rate for the month or quarter. This average is multiplied by the number of days in the period to provide an indication of the monthly or quarterly rate for each State (table 16).

The indicated monthly or quarterly rate from the survey is interpreted with a time-series chart to establish a preliminary estimate of rate per cow. Survey indications for the corresponding months or quarters in previous years are plotted along with final estimates of production per cow. As in the case of number of milk cows, rate-per-cow indications are analyzed on a State and national basis.

Total Milk Production

Estimates of total milk production in the current month are obtained by multiplying estimated number of milk cows by the estimated monthly rate of production per cow.

Estimates of production are reviewed by comparing them with the trend for recent months and with seasonal changes in production.

Supplemental check data on earlier months' milk production are available for most States, and are helpful in keeping the estimates at a proper level during the year. The nature and source of available monthly check data vary by States and include the following:

- Monthly State milk commission reports on plant receipts of milk from producers within the State.
- Milk receipts from producers at plants regulated by Federal marketing orders. In some States, these receipts represent a large percentage of all milk produced. In those markets where milk is received from several States, receipts are allocated to the States where the milk is produced.
- Milk receipts at a sample of plants compared with receipts a year earlier and a month earlier.
- Estimated change from a year earlier in the amount of milk used to manufacture butter and American cheese in States where these products use a large percentage of the total milk produced.

Revisions

In February, State estimates of monthly and quarterly milk production for the two preceding years are opened to revision. This allows monthly and quartery milk cow numbers to be reappraised on the basis of indications from the January 1 cattle inventory survey. Monthly, quarterly, and annual milk production estimates for the second year preceding are revised if necessary. By this time, a virtually complete enumeration of milk plant receipts is available.

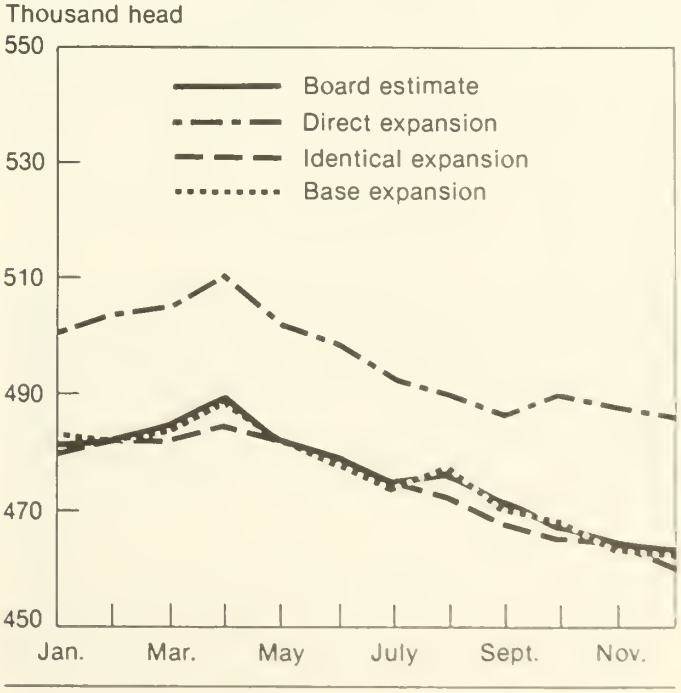
As data become available from the Census of Agriculture, milk production estimates may be revised for the 5 years preceding the current Census. However, for most States, total milk production is firmly established in annual revisions, based primarily on check data from plant receipts. Census data do provide a refined indication of the number of milk cows in each State, as well as the number of farmers keeping milk cows and delivering milk.

Grain and Other Concentrates Fed to Milk Cows

The average amount of grain and other concentrates fed daily to milk cows is published by State, based on surveys on the first of January, April, July, and October. The reported quantities fed are totaled for each stratum and divided by the number of milk cows (including those not being fed concentrates) reported in each stratum to obtain an average feeding rate per cow. The stratum rates are then weighted to form a State average. The computed feeding rate includes concentrates fed to dry cows as well as to those being milked.

Estimates of the average value per hundredweight of "concentrates fed" to milk cows are published quarterly and are based on survey indications of the average value of concentrates fed. The reported values include homegrown grains valued at current local prices and commer-

Figure 23. **Example of a Time-Series Chart for Estimating Milk Cow Numbers**



cial concentrates valued at prices actually paid by dairy farmers.

Production, Disposition, and Income

Estimates of the disposition of milk produced are made annually for each State with separate estimates of milk fed to calves, milk used in farm households, milk sold to plants and dealers, and milk retailed by farmers. The value of all milk produced is developed from these disposition estimates by application of annual average prices. These data are published each May for the preceding year in the *Milk Production, Disposition, and Income* report.

Milk Used Where Produced

Estimates of amount of milk used on farms are based primarily on indications from disposition questions on the April 1 and October 1 milk production surveys. Respondents report the quantities of milk from the preceding day's production fed to calves and used for food, buttermaking, or other purposes in farm households. The quantities reported are computed as a percentage of all milk produced on reporting farms the day before the survey. Percentages are computed by strata, which are then weighted by the indicated total milk produced in each size group to arrive at a percentage for the State. The average of the weighted percentages from the April 1 and October 1 surveys is applied to the annual milk production estimate for each State. Milk sucked by calves is not included in the estimate of milk fed to calves or that of total milk production.

Milk Sold to Plants and Dealers

Estimates of the amount of whole milk sold to plants are based primarily on receipts reported in the annual dairy plant survey in each State. Complete data on receipts of fluid-grade milk are available in States where monthly reports are required by a State regulatory agency or by administrators of Federal milk marketing orders. For other States, complete receipt data may not be available at the time of the annual plant survey. When data are lacking, preliminary estimates of milk sold to plants are based on other indications. In important dairy manufacturing States, for example, the change in production of manufactured dairy products furnishes an indication of the change in all milk sold. Preliminary State estimates are revised, if necessary, in the next annual disposition report based on more complete data.

Milk Sold Directly to Consumers

Estimates are made for the amount of milk retailed by farmers directly to consumers at the farm or on retail routes. The estimates include quantities of milk sold to neighbors as well as milk marketed by producer-distributors from their own herds. Milk produced by herds kept by public and private institutions such as hospitals or experiment farms is also included in this category. In several States, regulatory agencies require reports on sales by producer-distributors; such reports are useful in making estimates of milk retailed by farmers.

Farm Income and Value of Milk Produced

Separate estimates are made for cash received by farmers for whole milk sold to plants and for milk sold directly to consumers. The estimated annual sales volume is multiplied by annual average price per hundredweight for milk sold to plants and per quart for milk retailed by farmers to obtain cash receipts.

Total cash receipts from farm marketings of milk and cream are the sum of receipts for the two sales categories. Gross income adds to this the value of milk used on farms where it is produced.

Utilization of Milk Sold

A balance sheet comparing the amount of milk used with the amount produced checks the accuracy of the milk production estimate for the preceding year. The balance sheet is published in the *Milk Production, Disposition, and Income* report.

The balance sheet items are: (1) the whole milk equivalents of all dairy products manufactured in the United States, (2) the whole milk equivalents of net imports or exports of dairy products, (3) the whole milk equivalents of manufactured dairy products in cold storage at the beginning and end of the marketing year, (4) the milk used on farms where produced, and (5) fluid milk and cream sold to plants and directly to consumers. The last is primarily a summary tabulation of fluid milk sales from Federal milk market order statistics, State milk market orders, and plant survey data provided by SSO's.

If the calculated milk equivalents depart materially from estimated total milk production, the milk production estimates are reviewed.

Manufactured Dairy Products

USDA began providing annual statistics on the production of manufactured dairy products in 1917, because milk supplies were shifting rapidly to large processing plants rather than being used for farm-produced cream, butter, and cheese or for home deliveries by farmers. While annual surveys continued, monthly reports were inaugurated during World War II. SRS now reports production statistics for 25 major dairy products monthly and for 54 dairy products annually.

Monthly Survey

SRS issues monthly production estimates for butter, cheese by types, cottage cheese, canned evaporated and condensed whole milk, dry milk products, dry buttermilk, dry whey, condensed whey, ice cream, ice milk, sherbet, and Mellorine-type frozen desserts. Sample data for estimating monthly production of manufactured dairy products are obtained in most States by a mail survey of processing plants.

The sample is drawn from a complete list of plants in each State. The list is constructed with information from various State licensing and inspection agencies and from dairy magazines and periodicals, which often provide names and locations of plants going into and out of operation during the year. Lists are continually updated.

While reliable monthly estimates are possible from a sample of plants, an increasing number of SSO's conduct a complete enumeration each month, especially in States with few plants. This eliminates the need to ask the plant for annual statistics.

Laws in many States require State agencies to collect statistics as a part of a dairy plant licensing system. Such laws are helpful in obtaining complete statistics from all plants. In those cases where dairy manufacturing plants operate in more than one State, data are obtained from the headquarters or central office and forwarded by the SSO located in the headquarters State to other SSO's where plants are located.

Federal market orders, which are administered by AMS, require regulated dairy plants to file monthly reports with the market administrator's office, listing the utilization of Grade A milk in specified products. Under a cooperative agreement with AMS, milk market administrators forward selected data to SSO's. The SSO's generally arrange with the market administrator to have dairy plants report the production of finished products on the Federal market order report form. This joint report system eliminates the need for plants to respond to a separate SRS survey.

Plants that produce butter and cheese usually do not produce frozen products or cottage cheese. For each manufactured product, an adequate number of plants producing that product are included in the sample survey. Reliable estimates depend on the coverage of the sample plants for each product. A special effort is made to obtain data from all large plants each month, and a decreasing proportion of the plants is surveyed as plant size diminishes. Survey questionnaires are mailed to plants about the 25th of each month.

Current monthly samples include more than one-half of the plants on the list and usually account for 70 to 90 percent of total production of the major dairy products. Followup telephone calls, personal contacts, second requests, or other means are employed to maintain an adequate survey response.

All questionnaires returned to SSO's are reviewed and summarized. Special editing procedures include comparisons of milk receipts with manufactured products, and of the report for each product with the report for the previous month or year. Particular attention is given to the seasonal production pattern of each product. Any unusual change is carefully reviewed. This is especially important when a product is reported for one month and not for another. If it appears that data may be incorrectly reported, the plant is called for clarification. Data reported on a fiscal-month basis are converted to a calendar-month total before summarization.

Each SSO recommends a monthly production estimate for each product. When a complete enumeration is not obtained, monthly estimates are computed from indications of change, obtained by matching current survey reports with reports from the same plants for the previous month or year. SSO's submit recommendations to SRS headquarters for review and publication in national dairy reports.

Preliminary monthly estimates are released at the end of each month for the preceding calendar month to which they relate. All products are reported on a national basis; major products also are reported on a State basis.

Annual Survey

SSO's which do not obtain monthly data from all plants conduct annual surveys to collect information, by months, from the remaining plants. Most plants readily report their production each month or at the end of the year. SSO's make estimates for any plant not providing data at the end of the year, based on reports for previous years and other general information.

The annual *Production of Manufactured Dairy Products* report, published in late spring, contains production data from all plants for all leading dairy products, by months and by States. These products include butter; the principal kinds of cheese; various types of evaporated and condensed milk products; several kinds of dry milk products; whey products; processed cheese foods and spreads; major types of frozen products, such as ice cream, ice milk, sherbet, and Mellorine; and mixes for these frozen products. Data are obtained and published for water ices produced in dairy plants, because they are somewhat competitive with frozen dairy products. Data on the number of plants producing one or more dairy products are also published.

The annual publication also presents, by States, the calculated quantities of milk used in specified products, on a whole-milk and skim-milk equivalent basis. Whole milk equivalent is the quantity of producer milk at average milkfat content required to supply the milkfat used in a dairy product. As an example, 300,000 pounds of butter having 80 percent of milkfat is equivalent to 6.4 million pounds of milk with an average milkfat content of 3.75 percent:

$$300{,}000 \text{ lbs.} \times 0.80 = 240{,}000 \text{ lbs.}$$

$$240{,}000 \text{ lbs.} \div 0.0375 = 6.4 \text{ mil. lbs.}$$

Skim milk equivalent is the quantity of skim milk utilized in the production of the various nonfat and buttermilk products.

Dry Milk Products

The monthly *Dairy Products* report includes U.S. estimates of manufacturers' selling prices, shipments, and end-of-month stocks for nonfat dry milk for human food, dry skim milk for animal feed, dry buttermilk for human food, dry buttermilk for animal feed, and dry whole milk (bulk goods).

SSO's collect the basic data from central sales office headquarters and from individual plants within their States. Some multiple-unit companies and cooperatives with plants in several States report their entire operations from a central office, which facilitates data collecting and processing. Data are collected primarily by a mail questionnaire, with followup telephone calls to nonrespondents.

Statisticians examine the returned questionnaires for completeness and then forward a listing to Washington, D.C., for editing and processing. Reported prices which fall outside the range of a normal distribution array are excluded from the summaries. U.S. totals of shipments, end-of-month stocks, and average price per pound are computed and published for each product.

Revised totals of stocks and average prices based upon a near-complete enumeration are published annually in the January issue of *Dairy Products*. The revised data are reasonably close to the preliminary estimates published each month.

Evaporated Whole Milk

Information on manufacturers' end-of-month stocks of canned evaporated and condensed milk are collected monthly from condenseries by mail questionnaires, with telephone followup to nonrespondents.

Statisticians review the returns for completeness and then forward them to Washington, D.C., for final review and publication in *Dairy Products*.

Whey and Modified Whey Products

The monthly *Dairy Products* report includes U.S. estimates of production and stocks of whey products (human food and animal feed separately), including dry whey, reduced-mineral whey, reduced-lactose whey, lactose, and whey protein concentrate. In addition, production of condensed whey and whey solids in wet blends for animal and human uses are shown. Prices of condensed whey solids and dry whey are published for animal and human uses at the U.S. level.

SSO's collect the data primarily by mail with telephone followup to nonrespondents. The State SSO's edit, summarize, and make estimates of State production, stocks, and prices. Revised stocks are published in the next issue. This allows minor revisions to be available to the user in a timely fashion. Production revisions are shown in the *Dairy Products Annual Summary*.

Minnesota-Wisconsin Prices

SRS provides monthly estimates of the average price received by farmers and the average milkfat test for milk of manufacturing grade in the two-State (Minnesota-Wisconsin) area. This series (referred to as M-W prices) is used to price fluid and surplus Grade A milk each month in Federal milk marketing orders.

Minnesota and Wisconsin produce over half of the manufacturing-grade milk marketed in the United States. As a result there is competition for the supply within the two States, and the price is considered to represent the market value of milk utilized in the production of cheese, butter and its byproducts, and other dairy products.

The M-W estimate is an average price for all milk of manufacturing grade delivered in bulk tanks and in cans f.o.b. plant or receiving station, before hauling costs are deducted. It includes bulk-tank, quantity, or other premiums paid to producers, but excludes hauling subsidies. The price and test estimates for a given month are derived from two factors: the estimated average price and test for the base month, which is the month preceding that to which the M-W price estimate relates; and an estimate of change from the base month to the month to which the M-W price estimate relates.

The base-month price and test are based on reports from about 175 plants in Wisconsin and about 100 plants in Minnesota that purchase approximately 60 percent of all manufacturing-grade milk sold in the two States. Processing plants report the total pounds of manufacturing-grade milk received from producers, total pounds of milkfat in the milk, and total amount paid to producers.

The 275 plants in the base-month sample are well distributed geographically over both States and represent all the major types of processing plants using manufacturing-grade milk. At the end of the year, reports from all manufacturing-grade milk plants in each State indicate close agreement with the monthly prices derived from the sampled plants.

The estimate of price change from the base month is based primarily on a sample of 110 plants (about 40 plants in Minnesota and 70 in Wisconsin). These plant reports are also evaluated in terms of changes from the base month in wholesale prices of manufactured dairy products and historical price and fat-test relationships.

Plants in Minnesota and Wisconsin are classified into three major product groups according to the proportion of manufacturing-grade milk purchased for cheese, for butter and its byproducts, and for varied products. In both Minnesota and Wisconsin, the varied-products group consists mostly of plants which make butter, cheese, or other products in such proportions that they cannot be clearly classified in any one specific group, such as primarily buttermaking plants.

The percentages of milk for each use are used as weights for combining reported price and milkfat test data by groups for the monthly manufacturing-grade average price and milkfat estimates in each State. The estimated monthly price and fat test for Minnesota and Wisconsin are weighted together by the total quantity of manufacturing-grade milk purchased from farmers in each State. The percentages are based on final plant enumerations for the previous year and are changed once each year when enumerated data become available.

Data for the monthly M-W price series are collected from the 110-plant sample, using a questionnaire mailed near the close of each month. This inquiry obtains information for the base month and for the first half of the succeeding month relating to: (1) the quantity of manufacturing-grade milk purchased, (2) quantity of fat included, (3) payments to dairy farmers, (4) average price at average test, and (5) related information, such as quantities purchased in bulk and in cans, the base price for milk with 3.5 percent milkfat, and point differentials for varying amounts of fat. Space is also provided on the inquiry for the plant manager's best estimate of the average fat test and milk price for the last half of the month to which the M-W estimate relates.

The M-W price specified for use in Federal milk marketing orders is converted to a basis of 3.5 percent milkfat. Prices, at average milkfat test, are converted to a 3.5-percent basis by using a milkfat differential per point (1/10 of 1 percent) that is calculated by multiplying the average price of Grade A (92-score) butter at Chicago by 0.120.

The basic and preliminary data needed for the preparation of the two-State average price and fat test are collected, summarized, and analyzed by the SSO's in Minnesota and Wisconsin. The data are forwarded to Washington, D.C., for final review and consolidated into a M-W price. The report is issued the 5th of each month, or the last prior working day, from the Wisconsin SSO, and is also published and released by the AMS dairy market news service.

Four-State-Area Nonfat Dry Milk Prices

The four-State-area nonfat dry milk average sale price—often referred to as the Chicago-area nonfat dry milk price—is one of the determining factors in the price paid to farmers for milk under some Federal and State milk market orders.

SRS establishes the price from monthly survey data which note the average net price received by manufacturers for sales of nonfat dry milk solids. The surveys are confined to plants in Iowa, Michigan, Minnesota, and Wisconsin—important milk-producing States that represent an area of highly competitive marketings. Prices relate only to shipments of spray-process nonfat dry milk for human consumption, f.o.b. factory, after deduction of freight paid by processors and after discounts to wholesalers.

The survey covers shipments from the 26th of one month through the 25th of the next. This period is used instead of a calendar month to allow time for surveying plants and to compute the average price for release, which is usually on the fifth day of the month following the end of the reporting period.

Questionnaires are mailed to all spray-type drying plants in the four-State area. About half of the plants respond on a monthly basis, with reports representing about 70 percent or more of the production in volume of sales.

The SSO's review the returned questionnaires for completeness and then mail them to Washington, D.C., for processing. The data are edited and prices which appear erroneous are deleted. Shipments and prices are listed according to sales made to Government agencies, wholesalers, direct users, and others. Prices reported by individual plants are weighted by all types of sales to compute the weighted average monthly sale price.

The price is released through AMS dairy market news offices and the Wisconsin SSO at 12:00 noon eastern time on the release date.

Chapter 9

Poultry

Introduction

The SRS poultry estimating program began in 1919 with questionnaires sent to a small sample of poultry farmers each January. Estimates of turkey inventory numbers and production were added in 1929. Between 1937 and the midforties, several studies were made to develop poultry statistics on inventory numbers, chicken and egg production, disposition, marketing records, and commercial hatchery data. In March 1962, historical estimates of chickens, back to 1924 by State and back to 1909 for the United States, were published. Since that time, historic data have been published about every 5 years.

Today, SRS provides timely information on current and potential production for the poultry industry. These estimates include monthly layer numbers and egg production, weekly and monthly hatchery production, annual inventory and value, broiler production, turkey production, chickens raised, and monthly reports of poultry slaughtered, egg products produced, pullets placed in hatchery supply flocks by primary breeders, and percentage of layers force-molted (table 17).

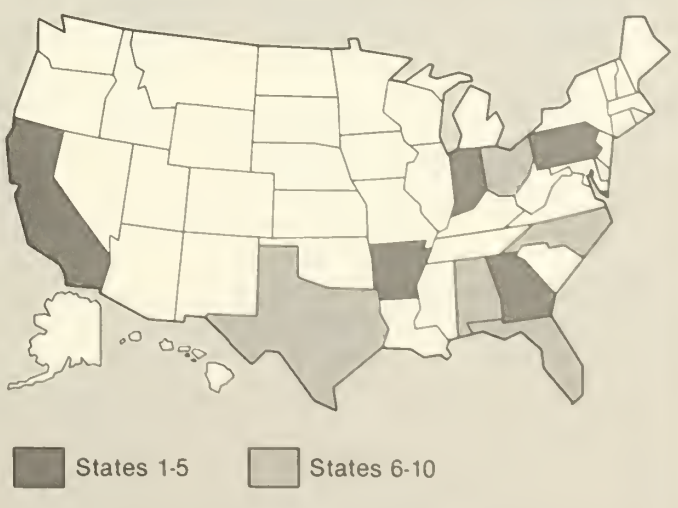
Poultry estimates are based primarily on sample surveys; however, many items are based on nearly complete enumerations. Estimates are regularly reviewed using check data, including the number of commercially slaughtered poultry, data from State farm censuses, and the U.S. Census of Agriculture. If necessary, revisions are published.

Chickens and Eggs

A monthly report, *Eggs, Chickens, and Turkeys*, releases estimates on the number of layers on hand, rate of lay, and eggs produced for 33 States and the United States, including separate estimates for flocks producing table eggs and those producing hatching eggs (see table 17 and State groupings in fig. 25). The report contains estimates for the 17 quarterly States as a group. The December, March, June, and September issues also contain estimates of the average number of layers, quarterly egg production for each State, and regional estimates of pullets 3 months old but not of laying age.

Figure 24. **Value of Egg Production**

United States



Leading States, 1982

Eggs, Chickens, and Turkeys gives monthly estimates of the percentages of layers being force-molted and with molt complete in the 17 States where this practice is the most prevalent. Also included in this report are the number of chicks hatched in commercial hatcheries during the month, number of eggs in incubators on first of the month, and the number of pullet chicks placed in hatchery supply flocks by primary breeders.

Egg Production

Three indicators developed from monthly surveys—the ratio-to-base expansion, the identical expansion, and the balance sheet indication—are used to estimate the number of layers on hand for each type of flock the first of the month.

The primary indicator, the ratio-to-base expansion, is derived by applying the percentage change measured from the survey to a base-period estimate. The number of layers on December 1, estimated using probability survey expansions (including a complete enumeration of all large operations), becomes the base for the succeeding months.

Table 17—**Calendar of poultry reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Eggs, Chickens, and Turkeys												
Number of layers, rate of lay, and egg production, by flock type, 33 States and United States	●	●	●	●	●	●	●	●	●	●	●	●
Quarterly average number of layers and egg production, all States and United States			●			●			●			●
Forced molting of layers, 17 States	●	●	●	●	●	●	●	●	●	●	●	●
For egg-type and broiler-type hatch: Eggs in incubators first of month, chicks hatched during month, pullets placed in hatchery supply flocks	●	●	●	●	●	●	●	●	●	●	●	●
Turkey eggs in incubators first of month, poults placed during month, light and heavy breeds	●	●	●	●	●	●	●	●	●	●	●	●
Turkeys raised during year, preliminary								●				
Turkey breeder hen intentions									●			
Broiler Eggs in Incubators and Chicks Placed Each Week, 19 States	(weekly)											
Layers and Egg Production												
Layer numbers, rate of lay, and egg production; December 1 inventory numbers and value	●											
Hatchery Production												
Monthly egg-type and broiler-type chick hatch; weekly broiler placements, 19 States; turkey placements; hatchery numbers and capacities (alternate years)			●									
Poultry Production, Disposition, and Income												
Production, disposition, and income for chickens, eggs, broilers, and turkeys				●								
Egg Products	●	●	●	●	●	●	●	●	●	●	●	●
Poultry Slaughter	●	●	●	●	●	●	●	●	●	●	●	●
Turkeys												
For light and heavy breeds: number of breeder hens, number of turkeys raised, growers' intentions	●											

Layer operations in each State are stratified by size groups and surveyed each month in the 33 major producing States and each quarter in the remaining 17 States. Data from the current survey are matched with data obtained from corresponding operations for the December 1 base period. A ratio is computed for each stratum and multiplied by the December 1 base estimate. The summation of stratum expansions becomes the ratio-to-base expansion for the State.

The identical expansion is similar to the ratio-to-base expansion except the ratio is the indicated change from the most recent monthly or quarterly estimate rather than a base period. The ratio is the number of layers reported in the current survey compared to the number reported the previous month or quarter for respondents in both surveys. These percentage changes, computed in each stratum, are multiplied by previous stratum estimates and summed to State expansions.

The balance sheet starts with the number of hens and pullets of laying age on December 1. Each month or quarter thereafter, survey expansions are used to estimate pullets added, and layers sold, died, and destroyed since the last survey. These estimates are accumulated to derive a check on each monthly estimate of layers. Related hatchery and slaughter data are also considered in making monthly estimates of the balance sheet components at the national level.

The indicated daily rate of egg production per layer for each type of flock is obtained from the first-of-month surveys by dividing the number of eggs produced by respondents' flocks by the number of layers in those flocks. This indicated rate of lay is computed by stratum and weighted by the number of layers in each stratum to arrive at a State estimate.

Estimates for the number of layers and rate of lay during any month are based on the simple averages of the two estimates corresponding to the beginning and ending of the month as discussed above. Monthly egg production per layer is obtained for each type of flock by multiplying the monthly average rate per day per layer by the number of days in the month. Monthly rate of production is then multiplied by the month's average number of layers to obtain total eggs produced during the month. For the 17 quarterly States, the indicated average number of layers and rate of lay for the quarter are computed similarly. The two-date averages are plotted on time-series and regression charts to adjust estimates for known seasonal variations during the longer quarterly period.

Forced Molting

Estimates of the percentage of layers being force-molted and the percentage that have completed one or more forced molts are prepared monthly for 17 States where this practice is most prevalent (see table 18). Percentage indications are obtained by computing a weighted ratio of birds reported in each catergory to the total number of layers (including layers molted and being molted) reported on hand on the first of the month.

Table 18—**States making estimates of chickens force-molted**

Alabama	Iowa	Pennsylvania
Arkansas	Mississippi	South Carolina
California	New York	Tennessee
Florida	North Carolina	Texas
Georgia	Ohio	Washington
Indiana	Oregon	

Annual Inventory and Value

The January *Layers and Egg Production* report publishes revisions of the monthly estimates of number of layers and egg production. It also includes estimates of the December 1 inventory of chickens, by States and for the United States. Inventory data include hens 1 year old and older, pullets of laying age, pullets 3 months old or older but not of laying age, pullet chicks under 3 months, and other chickens. The average value per bird and total value of chickens on December 1 are also reported.

Figure 25. **State Groups for Egg Estimates**

The December inventory estimates include all layers and replacement chickens used to produce table or hatching eggs. This estimate includes all egg-type chickens and that portion of broiler-type hens, pullets, and cockerels used for production of eggs. Since they are not commercial broilers, egg-type male chicks raised along with pullets for laying flock replacements are included, even though the males are used for meat. This would also include the laying flock for production of rock cornish eggs. Chickens produced exclusively for meat, such as broilers, fryers, roasters, capons, rock cornish, and some heavy pullets are not included in these estimates.

The December 1 inventory estimates of all chickens (excluding broilers) are based primarily on direct expansions from the DES. Percentage changes in expansions from year to year, along with hatchery and slaughter data, are also used in making annual inventory estimates. In addition, egg-type chick hatch data obtained from hatcheries and adjusted for imports, exports, and death loss provide useful checks on inventory size at the national level. This is especially true for pullets not yet of laying age.

The DES utilizes probability sampling procedures. The sampling procedure for chickens involves the use of two sampling frames, a list of chicken operations, and the area frame. A sampling unit for poultry surveys is defined as the individual, partnership, firm, or corporation that owns the chickens regardless of who owns the land on which the chickens are located and regardless of who makes the day-to-day decisions for the operation. The list sampling frame accounts for over 90 percent of all layers and includes all known chicken owners with 3,000 or more layers. Also included are all owners of hatchery supply flocks and owners growing only started pullets. A survey response is required for all list operations. The area-frame sample is used to estimate all chickens not associated with, or accounted for by, the list sampling frame.

The average value per bird is also obtained from the December survey of chicken and egg operations. This average value per bird, multiplied by the total number of chickens on hand December 1, gives the total value of chickens.

Production, Disposition, and Income

Estimates of the production and disposition of chickens and the income derived are published annually in April. These include estimates by States of the number and live weight of birds produced, consumed in producer households, and sold; cash receipts; gross income; and estimated death losses.

Estimates of the annual volume of poultry production in each State are developed from December 1 inventories. The latest inventory is subtracted from the preceding inventory to determine the increase or decrease in the number of birds on hand. Next, the number of birds produced and sold during the year are estimated, by subtracting death losses of birds that were on hand at the beginning of the year from the number raised during the year.

The annual death loss of chickens on hand at the beginning of the year is estimated from the monthly and quarterly surveys of poultry producers who report the number of layers that died during the preceding reporting period. Young chickens from the current year's hatchings that die are not included in the number raised.

The annual number of chickens sold is the number produced, adjusted for inventory changes, less the number consumed in poultry producer households. The State estimates of chickens sold are checked against available data on commerical slaughter of mature chickens. In using slaughter data, consideration must be given to birds produced in one State and slaughtered in another.

To estimate total pounds of chickens produced, it is necessary to determine the total live weight involved in the consumption and sales items. For each series of numbers, a corresponding series of estimated live weights by States is required. The average live weight used in this series is based on slaughter data and surveys of chicken operations.

The average live weight per bird is applied to the increase or decrease in the inventory number to obtain the change in inventory live weight. The number of pounds sold is the product of number of birds sold times the average live weight. Likewise, the number of pounds consumed in poultry producer households is the product of the number of birds consumed times the average live weight.

Production of chickens during the year is obtained by adding the total pounds sold to the total pounds consumed in the poultry producer households. This total is adjusted by the differences in live weight between inventories at the beginning and end of the year.

The value of annual production is determined by multiplying the total pounds produced by the annual average price per pound received by producers.

Cash receipts are obtained by multiplying the annual average price per pound by the total pounds sold. Value of chickens consumed in producer households is obtained by multiplying the annual average price by the total pounds consumed in producer households. Gross income is the sum of the cash receipts and the value of home consumption.

Chicken Hatchery Production

Data for hatchery estimates are obtained from a combination of weekly, monthly, and annual surveys of chick hatcheries. The hatchery universe comprises all known operations that hatch egg-type or broiler-type chicks on a commercial basis. Most hatcheries specialize in one type of chick, but some produce both. SRS attempts to get current reports from all hatcheries in States making weekly and monthly estimates. At the end of the year, an intensive effort is made to obtain missing information for hatcheries not reporting during the year, including data for hatcheries in a few minor States making only annual estimates.

Weekly broiler hatchery reports, the only weekly estimates, feature the number of eggs in incubators and chick placements in 19 States that produce over 95 percent of all broilers (table 19). Monthly estimates of broiler-type hatchings utilize the weekly data from the 19 States and monthly data from 10 additional States to establish eggs in incubators on the first of the month and chicks hatched during the month. Hatchery production of broiler-type chicks provides a measure of broiler slaughter 6 to 7 weeks after hatch. Monthly estimates of egg-type hatchings are made for 34 States and provide a continuous record of the potential supply of replacements for the laying flock.

Table 19—**States in the weekly broiler placement program, 1983**

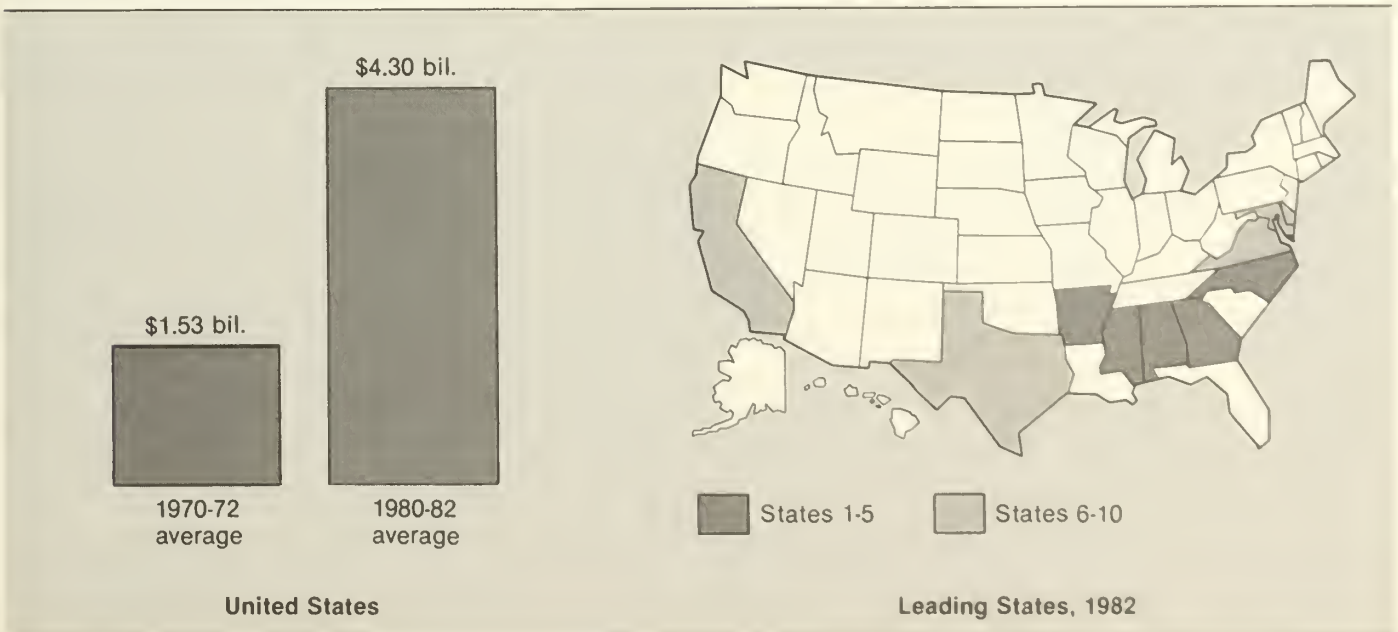
Alabama	Maryland	South Carolina
Arkansas	Mississippi	Tennessee
California	Missouri	Texas
Delaware	North Carolina	Virginia
Florida	Oregon	Washington
Georgia	Pennsylvania	West Virginia
Louisiana		

SSO's in the 19 States issue weekly estimates of number of eggs set and of broilers placed. Revised weekly estimates of broilers placed and eggs set in the marketing year beginning December 1 are published the following March in Washington, D.C. in the annual *Hatchery Production* report.

In making weekly estimates, questionnaires are sent to all broiler-type chick hatcheries in 19 major States. Followup telephone interviews ensure maximum coverage each week. Hatcheries report the number for broiler-type eggs set, broiler-type chicks hatched, and placement of chicks.

The chick placement estimate is the sum of the reported

Figure 26. **Value of Broiler Production**



chick placements plus the estimated number of chicks produced in hatcheries not reporting. The number of broiler chicks placed in a particular State consists of chicks produced by hatcheries in that State, plus chicks shipped in, minus those shipped out. Estimates of the total number of eggs set in each State are developed by summing the number reported during the previous week and adding an estimate of the number set in hatcheries not reporting.

In estimating the number of chicks hatched monthly, reports of hatcheries which report weekly are converted to a monthly basis by adding the full weeks in the month and parts of weeks that fall in 2 months. For such weeks, each day is given equal weight. For example, if 2 days are in 1 month and 5 days in the next month, two-sevenths of the weekly production is added to the first month and five-sevenths is added to the second month.

Reports are obtained from nearly all hatcheries on a regular basis, but, in the absence of a complete enumeration, an estimate for each missing hatchery is included in the State summary.

Broilers

Commercial broilers are young chickens of the heavy breeds marketed at 2-1/2 to 5 pounds live weight for meat production, including rock cornish, fryers, roasters, and capons.

The two main reports in the broiler production program are weekly chick placements in 19 major broiler-producing States (discussed earlier) and annual broiler production. Data for these reports come primarily from weekly and monthly surveys of chick hatcheries.

Estimates of broiler production and value of production are published each April in the *Poultry Production, Disposition, and Income* report. The estimates cover the 19 major States and States that produce 500,000 or more broilers a year. Value of production is derived from estimates of the number of broilers produced, average live weight, and average price per pound.

The number of broilers produced from December 1 to November 30 is estimated primarily from weekly placements minus estimated death loss, as well as data from hatcheries reporting monthly or annually. The growing period for broilers is 6 to 7 weeks; therefore, lagging chick placements 7 weeks provides an estimate of broiler production from hatcheries reporting weekly. Mortality is estimated from industry sources.

Average live-weight estimates for each State are based on slaughter data derived from administrative Federal and State inspection records and from trade sources. Gross income is computed by multiplying the average equivalent live-weight price received by the total live weight of broilers produced.

Turkeys

The turkey statistics program provides information necessary for timely and accurate analysis of the current turkey situation and future trends. Statistics are divided into heavy breeds and light breeds.

A report indicating the number of breeder hens that flock owners intend to keep for the coming hatching season is issued each September. The January *Turkeys* report gives the actual number of breeder hens flock owners had on hand December 1. Monthly turkey hatchery estimates for all States are reported in *Eggs, Chickens, and Turkeys*. The August issue includes a preliminary estimate of turkeys raised during the current year. The January report contains the end-of-year estimates of turkeys raised.

Breeder Hens

The 24-State report covering intentions to keep breeder hens, included in the September *Eggs, Chickens, and Turkeys* report, is based on a survey of all breeder-hen flock owners (see table 20). If possible, a complete enumeration is taken. Otherwise, estimates are made using the C/C matched-report indication. The same procedure is used to estimate the number of breeder hens on farms December 1 (carried in the January *Turkeys* report). December 1 breeder-hen estimates are revised, if necessary, the following August.

Turkey Hatchery Production

The placements of turkey poults in the preceding month and estimates of eggs in incubators on the first day of

Table 20—**States making estimates of intentions to hold turkey breeder hens, 1983**

Arkansas	Minnesota	Pennsylvania
California	Missouri	South Carolina
Colorado	Nebraska	South Dakota
Georgia	New York	Texas
Illinois	North Carolina	Utah
Iowa	Ohio	Virginia
Kansas	Oklahoma	West Virginia
Michigan	Oregon	Wisconsin

the month for 23 States are published each month in *Eggs, Chickens, and Turkeys*. Hatcheries respond to monthly questionnaires. Telephone followup ensures nearly complete survey coverage. Estimates are based on the sum of the numbers reported, with an allowance for any hatchery from which a response could not be obtained. If response is not complete, a C/C ratio based on matched reports is applied to the estimate of a year earlier to obtain an indication of current month hatchery estimates.

At the end of the year, all hatcheries not reporting during the year are surveyed by personal visit or telephone. These annual reports, coupled with monthly reports, are used as a basis for revising the monthly hatchery estimates of number of poults placed and of eggs in incubators. Revisions are published in the annual *Hatchery Production* report released in March.

Turkeys Raised

Turkeys are considered as raised in the calendar year in which they are marketed. Growers' intentions to raise turkeys during the coming year in 20 States are published in the January *Turkeys* report (see table 21). An early-season preliminary estimate of number of turkeys raised for the year is published in August, which includes estimates for each of the 20 States and the Nation. Final estimates for 32 States are published in the January report the following year.

Table 21—**States making estimates of intentions to raise turkeys, 1983**

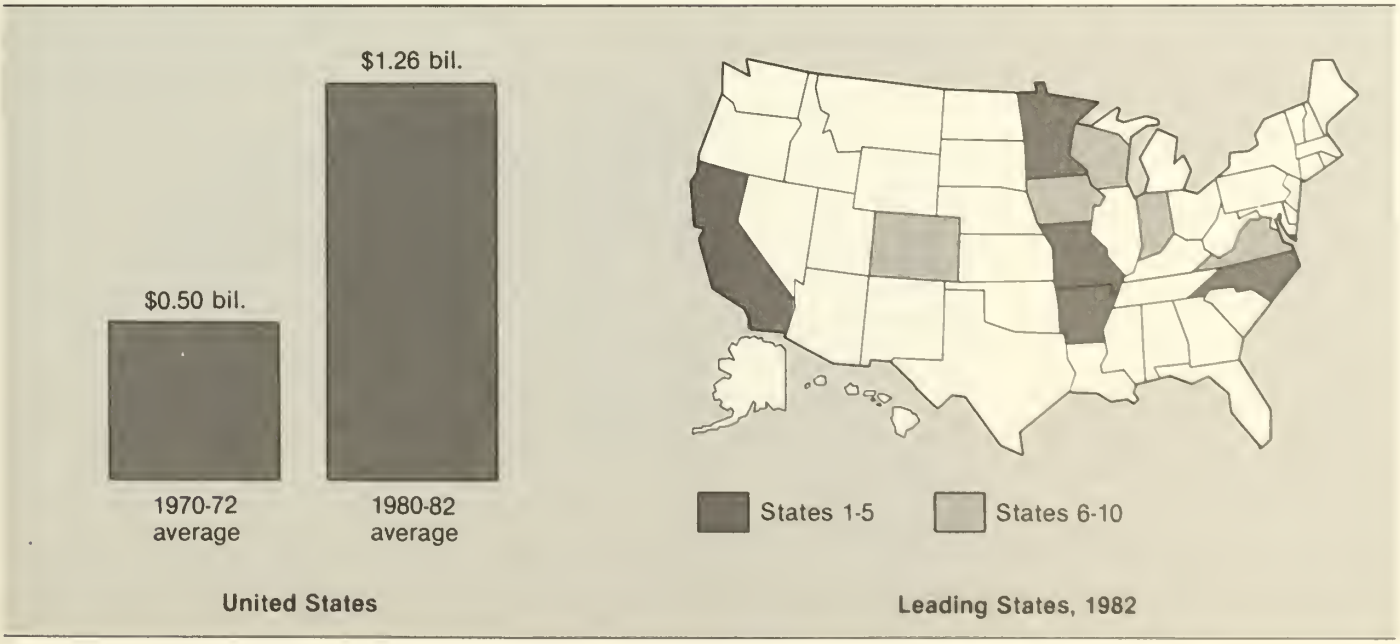
Arkansas	Missouri	South Carolina
California	North Carolina	South Dakota
Colorado	North Dakota	Texas
Georgia	Ohio	Utah
Indiana	Oklahoma	Virginia
Iowa	Oregon	Wisconsin
Minnesota	Pennsylvania	

Information about growers' intentions is obtained from a December survey of all known producers. The enumeration is as complete as possible.

Estimates included in the August report are based on hatchery data obtained from September through July of the current year, plus an estimate of the number of poults to be placed during August. Death loss estimates are subtracted from hatchery data to provide the major indications for turkeys raised during the year.

The January estimates of number of turkeys raised are based on the final estimates of poults placed during September of the previous year through August. The estimates of poults placed are adjusted for interstate movement and an allowance for home-hatched poults is added. The number raised is then obtained by deducting death losses, which are based on indications from the December turkey survey.

Figure 27. **Value of Turkey Production**



Turkey Production and Income

Each April, *Poultry Production, Disposition, and Income* reports live-weight pounds of turkey produced, price per pound, and value. The average live weight is estimated from survey and slaughter data; average price is estimated from AMS market news reports and information from producers. The average price multiplied by the pounds produced yields the value of production.

The March report also shows by region the percentages of young turkeys and breeder hens that died during the most recent 3 years. Data come from the December survey and industry contacts.

Pullet Chicks Placed in Hatchery Supply Flocks

The number of pullet chicks available for hatchery supply flocks is another important series of poultry data. This series includes placement data on the number of egg-type and broiler-type pullet chicks sold for hatchery flock replacement during the month, plus chicks expected from eggs sold during the preceding month by leading primary breeders. This report is an enumeration of all commercially important primary breeders and provides an indication of the potential number of pullets available for addition to hatchery supply flocks several months before the pullets actually move into the flocks. These statistics are published monthly in *Eggs, Chickens, and Turkeys*.

Poultry Slaughter

All poultry slaughtered in plants engaged in interstate shipments of dressed poultry is required to have Federal inspection. SRS publishes data on number of birds and live weight by classes of all poultry slaughtered under Federal inspection, and poultry inspected for further processing and cut-up, in the monthly *Poultry Slaughter* report. Data also include quantities of poultry condemned in both ante-mortem and post-mortem inspections. Number inspected is shown for young chickens, mature chickens, fryer-roaster turkeys, young turkeys, old turkeys, ducks, and other poultry. Data are obtained from reports submitted by FSIS inspectors.

SRS estimates poultry slaughter in plants not under Federal inspection annually. SSO's obtain data from State poultry inspection agencies and an annual survey of all nonfederally inspected poultry plants not reported by State agencies.

Egg Products

The monthly *Egg Products* report estimates the number of eggs broken at commercial plants operating under USDA inspection, by region and for the United States. Tabulations show the amount of edible liquid (whole, white, yolk, and total) and inedible liquid (not passing inspection); production of liquid, frozen, and dried egg products; and amount of liquid eggs used and ingredients added in processing by class of product. Liquid products are further separated into use for immediate consumption and processing. These data are based on reports of AMS poultry inspectors.

Chapter 10

Agricultural Prices

Overview

SRS estimates the prices that farmers receive for their commodities and the prices that they pay for production goods and services. These prices and associated price indexes, reported monthly, are an important barometer of agricultural markets, the economic well-being of farmers, and changes in production costs. SRS also issues monthly parity prices. Price and parity data figure importantly in formulas set by law that determine support prices and Government payments to farmers.

USDA started collecting prices received by farmers in 1866; early reports covered December 1 prices for 10 crops. Collection of "farm values" as of January 1 for six species of livestock began in 1867. Collection of prices as of the first of each month began in 1908 for eight crops, and during the next 2 years monthly prices received for livestock, poultry, and their products were added.

Monthly prices weighted to season-average prices have replaced the December 1 prices for valuing crop production and sales. January 1 values have continued to be used to value inventory numbers of livestock, except for hogs and poultry, which were based on a December 1 value starting in the late sixties. Beginning in 1924, prices received were collected as of the middle of the month instead of the first. The series for the earlier years were converted to a midmonth basis to preserve continuity.

From time to time, commodities have been added and dropped. Few new commodities have been added since the midthirties, but several new price series have been added or expanded for reported commodities. In 1944, weights for aggregating State prices to the U.S. price were shifted from production to estimated sales. Most regional prices were discontinued in January 1973.

USDA started collecting annual information on prices paid by farmers for 86 items used in farm production and family living in 1910. Surveys were quarterly from 1923 through 1936. In 1937, the frequency of the sur-

SRS estimates both the prices that farmers receive for crops and livestock and the prices they pay for production goods. Producers and firms that sell to farmers provide much of this price information.

veys was changed to semiannual, quarterly, or monthly, depending on the item being surveyed. Currently, prices are surveyed for over 200 farm production inputs.

The monthly *Agricultural Prices* report is the primary vehicle for publication of SRS price estimates, price indexes, and parity prices (table 22). The report is released from Washington, D.C. at 3 p.m. eastern time on the last working day of each month. The *Agricultural Prices Annual Summary*, issued in June, provides a detailed summary of revised prices and indexes for the previous year.

Prices Received

The concept used to estimate prices received by farmers is that of a price which, if multiplied by the total quantity of the commodity sold, would give the total amount received by all farmers for that commodity. That is, the estimated price reflects prices received by farmers for all classes and grades of the commodity being sold, including quality premiums or discounts. Estimates generally relate to prices farmers receive for their products at the point of first sale, usually a local market, or the point to which farmers deliver their products.

The primary reason for this definition of price is that one of the chief uses of the price data is to value marketings of commodities and thus develop estimates of income to agriculture, which are part of the national income accounts. If the result of multiplying quantity sold by price is to be meaningful in terms of cash receipts from sale of an agricultural commodity, the price must represent the average of all grades of the commodity sold.

The various series of prices received by farmers include monthly prices for most major agricultural commodities; marketing year or season-average prices for all commodities for which production is estimated; prices by utilization—mainly for milk, fruit, and vegetables; prices by States for most commodities and by specified areas for a few commodities; equivalent prices by location in the marketing channel for citrus fruit; and December 1 or January 1 inventory values for livestock and poultry.

SRS estimates prices received by farmers monthly for about 60 of the more important crop and livestock items, and on an annual or season-average basis for some 30 additional items. The latter generally have either relatively short marketing seasons, or their final settlement prices are not established until after the commodity is marketed. Fruit and vegetable crops used for processing are sold under contracts with price adjustments for yield and quality so that prices are not finalized until all the crop is delivered. Only a season-average price is estimated for States where monthly marketings are not adequate to obtain reliable prices using sample surveys.

Monthly Prices

SRS publishes preliminary monthly prices received by farmers on the last working day of each month in *Agricultural Prices*. These prices are based on data reported for the first 2 weeks of the month or at the middle of the month (from the 13th through the 17th).

Preliminary monthly prices are subject to revision the following month when data for the entire month become available. Entire-month prices generally are associated with reported marketings or purchases which are used to arrive at a weighted price.

Preliminary State prices are usually weighted to the U.S. price on the basis of current production estimates and historic sales patterns. Methods used to collect information on prices received varies among commodities. SRS bases its estimates of prices of the major crops and livestock on data from probability sample surveys of firms that purchase the commodities directly from producers. Prices for commodities such as fruit or vegetables come primarily from market check data or grower and buyer reports.

In States where fruit and vegetables are of major importance, prices are obtained separately for both fresh market and processing sales. Monthly prices are estimated only for fresh market sales, except for citrus fruits. Average prices of deciduous fruits sold for processing usually apply to bulk fruit delivered to the processing plant. Most deciduous fruit sold by growers for processing changes ownership at this point. Prices are also estimated for the major utilizations, such as canning, drying, freezing, and crushing.

Reported "average" prices may not reflect the actual proportion of sales by the various end uses and method-of-sale categories. For this reason, when price and quantity data by utilization are available, average prices for all sales are derived by weighting the price for each method of sale or utilization by the appropriate quantities sold.

For fruit, adjustments are made in prices to shift to a point of sale other than that at which the sale was actually made (for example, "f.o.b. shipping point to packinghouse door"). These estimates are called "equivalent per-unit returns" to growers and are usually calculated for two points of sale. Equivalent "packinghouse door" returns refer to the price for all fruit, regardless of method of sales, converted to the price at the packinghouse door. Equivalent "on-tree" returns refer to the price for all fruit, converted to the price if sold on tree. Before the marketing season starts, States converting to "equivalent returns" contact growers, handlers, and shippers to determine the harvesting and marketing costs. Cost studies from outside the agency may also be used. Based on these data, conversion factors are established for calculating "equivalent returns" for the following marketing season.

For production of some commodities such as broilers, integrated firms supply a sizable share of the production inputs to the farmer and pay fees for the farmer's services and use of equipment, land, or buildings. These integrated firms further process the commodity after it leaves the farm. Price information is available for the processed commodity, but no actual farm prices are available for the item before it moves into processing channels. In these cases a "farm price" is derived from the processed price. Market prices for broilers on a ready-to-cook basis are used to estimate "equivalent live-weight" farm prices.

Prices are not estimated for a State when the monthly sales are less than 0.5 percent of expected sales for the year. For commodities with highly seasonal marketings, some months will have no prices.

Marketing-Year and Season-Average Prices

U.S. marketing-year prices are prices weighted by marketings for the 12 months beginning the previous December for poultry, eggs, and hogs; and for the calendar year for the other livestock species and products.

Table 22—**Calendar of agricultural prices reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Agricultural Prices												
Prices received for field crops, citrus and noncitrus fruit, livestock, milk, poultry;	●	●	●	●	●	●	●	●	●	●	●	●
Prices paid for:												
Autos and trucks					●						●	
Building materials		●		●		●		●		●		●
Farm machinery			●			●			●			
Farm supplies		●			●			●			●	
Feed	●	●	●	●	●	●	●	●	●	●	●	●
Fertilizer			●		●					●		●
Fuels	●	●	●	●	●	●	●	●	●	●	●	●
Motor supplies	●			●			●			●		
Seed;				●					●			
Indexes of prices received, 11 commodity categories; indexes of prices paid for 12 categories of production items, farm services and cash rent, interest, taxes, wage rates;	●	●	●	●	●	●	●	●	●	●	●	●
Parity prices	●	●	●	●	●	●	●	●	●	●	●	●
Agricultural Prices Annual Summary												
Monthly and annual prices and indexes of prices received and paid						●						
Farm Production Expenditures												
Results of annual farm production expenditures survey;												
Preliminary						●						
Final							●					

Season-average prices for crops are weighted by sales during the marketing season. For a given crop, the marketing season for a State is the 12-month period beginning in the month in which harvest is usually actively underway. The corn marketing season begins on October 1 in the year of harvest in most States, but on August 1 in some Southern States. Thus, the U.S. season-average price may reflect sales made in various 12-month periods. When harvest of a crop in a State extends into 2 calendar years, the marketing-year designation is the one in which harvest is most active except for citrus fruit, which are given a 2-year designation covering bloom and harvest.

In some years, the Government acquires ownership of agricultural commodities under price-support or income programs. Season-average prices include an allowance for the value of the quantities taken over by the Government, but monthly prices are not adjusted to include this allowance. For some commodities, the Government makes supplemental payments on all or a part of the actual production, or potential production. These payments, such as deficiency payments for grain, are not included in monthly or season-average prices. The payments are shown under "Government payments" for farm income calculations.

U.S. Prices

The U.S. monthly and annual prices for all commodities are derived by weighting the State prices by their respective sales. The weights for the monthly prices are estimates of quantities sold in each State during the month. The quantities sold changes each month, especially for the crops which have seasonal marketing patterns. Thus, the relative weight of a State in the computation of the U.S. price varies from month to month. Differences in price levels and shifts in weights between States may change the U.S. price more or less than the sum of changes for individual States. Other factors that influence changes in the U.S. price are commodity quality, shifts in utilization (for example between fresh market and processing), change in the type of commodity marketed (tobacco types), relative movement of old and new crops, and importance of contract deliveries.

Price Revisions

Published prices are subject to annual revision if additional data become available. Revisions of monthly prices are usually published at scheduled times. This schedule is shown in the index of special features in the December issue of *Agricultural Prices*. Revisions of monthly prices are usually made when the marketing-year or season-average prices are published. Marketing-year prices for livestock and poultry are published after the marketing year is complete. Preliminary season-average prices for most crops are published prior to the end of the marketing year. Except for cotton, these preliminary season-average prices for crops are based on monthly prices to date with an estimate for the remainder of the season. Forecasting of cotton prices is prohibited by law. When the marketing season is over, the monthly prices or other indications for the entire year are included in the averages. These end-of-season average prices are subject to further revision when production estimates are revised the following year or in the 5-year review. Very few prices are revised in this review. However, revisions in the production, sales, or utilization estimates, which are used to weight the prices, will change prices at the national level.

Data Collection

The universe for prices received by farmers is theoretically all sales in which the ownership of farm products is transferred from the producer to the first buyer in the marketing process. Over 200 agricultural commodities are produced in the United States. Marketing practices are constantly changing and method of marketing varies from commodity to commodity and from area to area. Scarcely a product is marketed today in the same manner as it was a half-century ago. Collecting valid and meaningful price data, once a relatively simple operation, has become very complex. Since developing a complete sampling frame of all buyers of farm products would far exceed the resources available, compromises must be made. For most commodities, certain marketing channels are well defined and account for most marketings. SRS directs its data collection primarily to those channels. Since prices of many farm products fluctuate seasonally, data for most commodities are collected currently throughout the marketing season.

Prices received by farmers for products they sell are collected with the voluntary cooperation of buyers and sellers. Buyers are usually surveyed rather than producers, since one buyer's report covers the actual transactions of many sellers. In general, reporters may be classified in broad groups: independent local buyers—elevators, produce dealers, and livestock yards; cooperative marketing organizations; Federal milk market administrators, State fruit boards and other marketing agencies; processors, canneries, and slaughtering plants; and producers or growers. Use is also made of data

available from other Government agencies, industry associations, or other sources. These data vary in usefulness, depending on accessibility, timeliness, and completeness. Records from cooperatives, auctions, or market administrators provide virtually complete price and quantity information for some commodities and market segments. For example, auction sales provide complete a census of all sales by growers for some types of tobacco. Records of the Federal or State milk market administrators provide detailed data on sales of milk eligible for the fluid market in regulated areas. For grain and livestock, daily market price reports provide indications of price changes within specified quality gradations, but do not represent a weighted average price for actual transactions.

The increase of forward contracting at a set price, for delivery at harvest or later, has added another dimension to collecting and estimating average prices received by farmers. Contract and open-market prices may differ significantly for a given delivery period. Some SRS price questionnaires include questions relating to both prices and quantities for contract and open-market delivery. Income or loss from hedging or trading in futures markets is not considered a part of the prices received program.

A general-purpose questionnaire for a number of commodities, once used on a broad scale, is no longer adequate for estimating prices received by farmers. Special inquiries are used extensively for livestock, crops, vegetables, fruits, nut crops, and specialty field crops. Price data alone are not accurate enough to estimate prices for most commodities; quantities or utilizations are needed for weights. Milk data are collected in pounds purchased and total dollars paid. Information on quantities purchased and price is collected for most of the major livestock, field crop, and fruit and vegetable items.

For some commodities, such as milk and eggs, SRS asks respondents to report prices by grades or other breakdowns. SRS believes a more accurate price is obtained by combining the reported data on quantities, grades, and utilizations with prices or values than by asking respondent to report one composite price.

Probability sample surveys are now used to collect price data for most of the major crop and livestock commodities. This increases accuracy, gives greater quality control, provides a method for estimating sampling error, and uses a smaller but more representative sample.

The following paragraphs describe the methods used for several probability surveys.

Probability Livestock Survey

The probability livestock price survey, operational since 1981, surveys auctions, stockyards, packers, and dealers that purchase livestock in 37 States each month for data on actual transactions made by farmers selling cattle, hogs, and sheep. The 37 States account for about 90 percent of U.S. marketings. Respondents report data for the previous month, including the number of head sold, total live weight, and dollars received by the farmer. SSO's expand and summarize these data to produce indications at the State level for total hundredweight marketed and average price. State prices are weighted to a U.S. average price using expanded marketings. Respondents in the sample are selected from lists of all known auctions, stockyards, packers, and dealers in a State. Frequency of selection is proportional to the volume of livestock handled annually. A new sample of firms is drawn about every 3 years.

The survey prices, as noted, apply to the previous month. SSO's also estimate preliminary midmonth livestock prices for the current month. These prices are based on check data which are usually obtained from local Market News Service and auction-market reports. The price level of the check data around the middle of the current month is compared with the level for the previous month. This change in price level is applied to the revised Board price of the previous month to estimate a current midmonth price. This preliminary price is then subject to revision the following month when the entire month's data are available from the probability survey.

Probability Grain Survey

Prices farmers receive for nine grain crops (corn, soybeans, oats, barley, rice, flaxseed, wheat, grain sorghum, and sunflowers) are estimated from a monthly probability sample of mills and elevators in 35 States that purchase grain from producers. The States surveyed account for about 90 percent of U.S. sales for each commodity. Probability grain price surveys began in 1977.

The sampling universe for the grain price survey is a list of about 14,000 mills, elevators, and warehouses. Lists are stratified into size groups according to capacity and kinds of grain purchased. A sample is systematically selected from the stratified universe in each State. Samples are redrawn each year to reduce reporting burden.

Questionnaires ask for the total quantity for each crop purchased for the previous month and the total dollars

paid to producers for that quantity. Purchased quantities and dollars are expanded to State-level indications. These are aggregated to obtain the weighted national price. For the current month, a midmonth price for each of the crops (without quantities purchased) is reported. This preliminary price is then subject to revision the following month when entire-month purchases and prices become available.

Data for sampled firms are collected each month by mail, telephone, and personal enumeration. Personal enumeration is used for the first contact and periodically thereafter, with mail or telephone contact used at other times. Nonrespondents are contacted by telephone or personally enumerated.

Probability Cotton Survey

A probability cotton price survey was initiated in 1974 to provide more reliable data, gather information on monthly marketings, and ensure that all types of sales (including those sold under contract) were represented. Monthly marketings are very important for weights because cotton deficiency-price payment levels are based on the calendar-year average price received by farmers, weighted by marketings.

The universe of cotton buyers (about 800) is updated annually and used to develop a stratified random sample of buyers for each major cotton State. Actual bales reported on the sample survey normally account for about one-half of the cotton production. Each month a questionnaire is mailed to selected sample buyers. Nonrespondents are contacted by telephone or personally enumerated.

The questionnaire asks for bales purchased and dollars paid for the first 2 weeks of the current month and bales and dollars paid for purchases during the entire previous month. Procedures for obtaining the State and U.S. monthly prices and later revisions are similar to the surveys just described.

Summarization and Estimation Procedures

Procedures for preparing agricultural prices estimates parallel those used for crop and livestock estimates. SSO's collect, review, and summarize price data each month, and expand survey data to the State level. After reviewing these results, State statisticians make preliminary price recommendations for each commodity, departing from survey indications only if there is conclusive evidence of survey bias or incompleteness.

Each SSO transmits its recommendations and survey indications to Washington, D.C. over a telecommunications network. Statisticians in the Estimates Division evaluate each State's price recommendations. They may adjust State recommendations on the basis of additional data available at the national level. Once prices for all commodities are reviewed and final U.S. averages adopted, the U.S. prices are available for computing the prices received index. State and national price estimates and commodity indexes are published monthly in *Agricultural Prices*. A detailed summary of revised prices and indexes for the previous year is issued in the June *Annual Summary*.

Data Reliability

Surveys are generally designed to provide a CV of less than 1 percent at the U.S. level and less than 5 percent at the State level. Major crop and livestock items have CV's well below 1 percent, often below 0.5 percent at the U.S. level, and as low as 2 percent to 3 percent for major producing States. Data users should be aware that nonsampling errors may be as large or larger than the sampling errors. The Prices and Labor Branch can provide more specific information on commodity specifications, survey coverage, and other questions on suitability and reliability of the data series.

Prices Paid

The prices paid series reflect average prices paid by farmers for a wide variety of items used in the production of agricultural commodities. Prices are obtained from firms that sell goods and services to farmers and ranchers. Prices paid reflect the average price of items farmers actually purchase. The price paid for a given item should, conceptually, be the average price which results from dividing the total amount farmers spent for the item in a given period by the number of items bought. Thus, the average price, when multiplied by quantity purchased, would equal total expenditures for the item. However, it is seldom possible to obtain the data needed for such a computation. In pricing most items, emphasis is placed on the kind "most commonly bought by farmers" or the "volume seller" as representing the price for the item to be reported. The kind most commonly sold in one community may not be the same in another, and the volume seller in one month may not be the volume seller in the next. However, the average of the prices compiled from all reports should represent the items purchased by farmers during the pricing period.

The survey emphasizes comparability in terms of economic use and function by providing respondents with general specifications for the items to be priced. This prompts them to report prices of comparable items on successive surveys. For example, a respondent should price a new model with the same functional use as an old one, even if styling or technology has changed.

Each farm input item priced is selected to represent other similar items, because surveying a complete list of production input items would be prohibitive. Currently over 200 production input items are surveyed periodically—monthly, quarterly, every 4 months, or semiannually.

Data Collection

The frequency of surveys is based on the importance of items in the index of prices paid by farmers and on price volatility. Table 22 lists the major surveys.

SSO's collect data by mail questionnaire, telephone, or personal interview for all items except retail seed prices, which are surveyed from Washington, D.C. The questionnaires used for some commodity surveys are regionalized to accommodate the varying purchasing patterns in different parts of the country. Questionnaires are also "seasonalized" to allow for inclusion of seasonal items and to keep the questionnaires from becoming too lengthy.

Personal interviews provide up-to-date information on trade practices, pricing, and discounting. Personal interviewing of auto and farm machinery dealers is especially important since discounts and rebates are frequently available but difficult to obtain in mail or telephone surveys.

Prices for items periodically surveyed are published in *Agricultural Prices*. U.S. prices are published in the same month as the survey. State prices are published in the month of survey for feed, fuel, and seed. Fertilizer prices are published by regions in the month of survey. State prices for motor supplies and regional prices for building materials, farm machinery, farm supplies, and pesticides are published in the *Agricultural Prices Annual Summary*.

Sample Universes

The universe for prices paid is, conceptually, the totality of all purchases by farmers to acquire the goods and services used for farm production. It is readily apparent that construction of a complete current sample frame of all retailers and other dealers who sell to farmers would be impossible. As a practical expedient, information on prices paid is collected from samples consisting of firms or producers that are likely, or known, to sell directly to farmers.

Farm operators interviewed during annual farm production expenditure surveys report the firms patronized and types of goods and services purchased during the previous year. From this information, sampling frames are constructed by commodity group and samples of firms are selected to be surveyed.

Farmers themselves supply data for certain commodities or services, such as feeder pigs purchased. Quarterly estimates of prices paid by farmers for feeder pigs in the 10 major hog-producing States are obtained from farmers responding to quarterly hog and pig surveys. Intraquarterly price estimates for feeder pigs are based on feeder pig sales at selected auctions and on AMS market news reports.

Data from other Government agencies such as the AMS Market News Service are used to estimate a preliminary feeder cattle price for the current month. The previous month's price is based on prices from the probability livestock survey. Sales of cattle weighing less than 800 pounds are used to estimate a weighted U.S. price for stocker and feeder cattle.

Telephone and Electric Survey

The annual telephone and electric survey is designed to obtain information on farm usage and costs. Data are published in the October issue of *Agricultural Prices* for average monthly local telephone bills, total monthly telephone bills, killowatt-hours of electricity used, monthly electric bills, and cost per killowatt hour. These data are published by State.

Reliability

Current methods of summarizing prices paid data are not designed to calculate sampling variability. However, several research studies indicate that CV's are in the 1-percent to 3-percent range at the U.S. level and around 5 percent for data published at the State or regional level.

Price Indexes

Index numbers of prices received by farmers for 10 crops were first published in 1909. The indexes used the

average December 1 farm prices for 1866 through 1908 for computing price relatives, and quantities produced in 1909 as weights. The number of commodities in the indexes were expanded, and by 1918 a livestock price index was introduced. In 1924, USDA's Bureau of Agricultural Economics published a new, restructured series of price index numbers for farm products. At this time, the major components were grains, fruit and vegetables, cotton and cottonseed, meat animals, dairy and poultry products, and unclassified commodities. The new series included prices for 30 commodities and used a base period of August 1910 through July 1, 1914.

About the same time, the Bureau of Agricultural Economics published the first index series measuring the price changes in commodities purchased by farmers for use in agricultural production and family living. Data on input product costs and family living expenses had been collected since 1910, but were not published until 1928.

The indexes of prices received and paid by farmers were revised extensively following the 1933 Agricultural Adjustment Act. This act declared that the policy of the Congress was to establish prices to farmers at a level which would give agricultural commodities the same purchasing power as they had in a base period. The indexes of prices received and paid were used to measure the purchasing power of agricultural commodities. Thus, the parity concept was developed.

The indexes were revised in 1950, 1959, and most recently in 1976. With each revision, the coverage provided by the index became more complete. For the prices received index, the structure of subgroups and commodities established in the 1950 revision was maintained in later revisions with only minor commodity changes. The farm production index subgroups of the prices paid index have had major revisions. The continual change taking place in the agricultural inputs used by producers makes it necessary to substitute commodities as producers shift purchases to new or improved products. The substitution of the consumer price index (CPI) for the family living component in 1977 provided the index with more complete coverage of family expenditures and reduced duplication in data collection.

Index of Prices Received by Farmers

The 37 commodities represented in the prices received index in January 1983 accounted for nearly 90 percent of total cash receipts from farm marketings during 1971-73.

The index of prices received by farmers is basically a fixed-weight aggregative price index, modified from the Laspeyres formula. Average marketings multiplied by average prices for the 1971-73 base-weight period (prices times quantities) provide the basic aggregates. Individual subgroup indexes are aggregated using the 1971-73 average marketings as quantity weights. The current monthly subgroup aggregates are divided by the 1971-73 aggregate to derive the subgroup index on the 1971-73 = 100 base. Subgroup percentage weights are computed using income from marketings, including income from commodities not in the index. These percentage weights are then used to combine the subgroup indexes into the overall index. The indexes are then converted to the 1910-14 = 100 and 1977 = 100 bases for publication in *Agricultural Prices*.

The index of prices received by farmers has two major groups: crops, and livestock and livestock products. The all-crops index is calculated by combining eight subgroup indexes: food grains; feed grains and hay; cotton; tobacco; oil-bearing crops; fruit; commercial vegetables; and potatoes, sweetpotatoes, and dry edible beans. In addition, indexes of feed grains, fresh market fruit, and fresh market vegetables are calculated as separate subgroups. The livestock and livestock products index is calculated by weighting the meat animals, dairy products, and poultry and eggs subgroup indexes. The all-farm-products index is computed by weighting the all-crops and the livestock and livestock products indexes.

The 1971-73 base-weight period is the fourth update of the index series. SRS uses linking procedures to maintain a continuous index series from one weighting period to another. Indexes are computed using old and new base weights and then converted to a common base period. The two index series are compared to find months where the indexes have the smallest difference using either base-weight period. Then a point is selected as the link month.

Index of Prices Paid by Farmers

The index of prices paid (the index of prices paid by farmers for commodities and services, including interest, taxes, and farm wages) has five major components. In terms of farm expenditures, the two major components are the index of prices paid for commodities used in farm production and the index of prices paid for commodities used in family living. The remaining three are interest paid per acre for loans secured by farm real estate, taxes payable per acre on farm real estate, and

wages paid to hired farm labor. Currently, the production component contains 12 subindexes: feed, feeder livestock, fuels and energy, farm and motor supplies, autos and trucks, tractors and self-propelled equipment, other machinery, building and fencing materials, fertilizer, seed, agricultural chemicals, and farm services and cash rent.

The index of prices paid, as is the index of prices received, is a fixed-weight price index modified from the Laspeyres formula and currently computed on a 1971-73 base-weight period. Indexes are converted to 1910-14 = 100 and 1977 = 100 bases for publication in *Agricultural Prices*. The weighting pattern for the index of prices paid is derived from surveys of farmers' expenditure patterns for 1971, 1972, and 1973. Average expenditures per farm are used to derive percentage weights for combining group and subgroup indexes and to derive weights for items selected for commodity indexes.

It is not feasible to include all of the items farmers purchase in the index. Also, quantity data on purchases are not available for most items since they are purchased by both farmers and other consumers. Items representing the largest expenditures are usually selected for pricing within each commodity index group and are used to represent a host of similar items not priced. Expenditures for the selected item and the similar items it represents are aggregated. This expenditure is then divided by the 1971-73 average price for the selected item to obtain a base weight. Not all expenditures can be associated with an item selected for pricing and not all items fit into an existing index category. In these cases, the expenditures are imputed into either the subgroup index or the overall index.

Feed-Price Ratios

Feed-price ratios indicate whether price relationships between feed and livestock are becoming more or less favorable. The ratio is the amount of feed equal in value to the farm price of a unit of livestock commodity. The feed units and prices used for milk, egg, broiler, turkey, and hog ratios are shown in table 23.

Table 23—**Equivalent feed and price components, feed-price ratios**

Feed-price ratio	Type and unit of of feed	Type and unit livestock priced
Milk-feed	16-percent dairy feed, lb.	Farm price, 1 lb. of whole milk
Egg-feed	Laying feed, lb.	Farm price, 1 dozen eggs
Broiler-feed	Broiler grower feed, lb.	Farm value, 1 lb. of live broiler
Turkey-feed	Turkey feed, lb.	Farm value, 1 lb. of live turkey
Hog-corn	Corn, bu.	Farm price, 100 lbs. of live hogs

Parity Prices

Parity prices for farm products were first defined by the Agricultural Adjustment Act of 1933, which declared it the policy of Congress to "reestablish prices to farmers at a level that will give agricultural commodities a purchasing power, with respect to articles that farmers buy, comparable to the purchasing power of agricultural commodities in the base period 1910-14." The parity price is the price a farmer would have to receive today for a unit of a farm commodity—say, a bushel of corn—to obtain the same purchasing power, or exchange value, in terms of farm and household goods and services that a bushel of corn would have had in the 1910-14 base period. Congress chose the 1910-14 base period because price relationships in the agricultural and other sectors of the economy were reasonably well balanced.

Parity prices are computed in terms of prices received by producers at the point of first sale. Prices received by farmers usually relate to the average of all classes and grades of a commodity sold by farmers; the same is true of parity prices. Parity is a national concept; parity prices and ratios are not computed by States or for specific markets.

Data used for calculating parity prices are average prices received by farmers during the last 10 years; therefore, seasonal elements are largely averaged out. Parity prices are not adjusted for seasonal variation. For commodities that have a strong seasonal variation (eggs and wholesale milk), the monthly prices received by farmers are seasonally adjusted for comparison with the parity price.

Parity Concept Limitations

It is important to understand the limitations of parity prices. The parity price formula is based on price relationships. It does not measure cost of production efficiencies, standard of living, or income parity. It is not a comprehensive measure of the economic well-being of farmers, as prices are only one component in cost of production and income. Inasmuch as the base period for comparison specified by law is 1910-14, ratio-to-parity comparisons do not take into account the many technological developments that have affected the size and efficiency of farm operations.

Three major changes in the legislative definition of parity have been made since 1933. These were to include interest on mortgage debt secured by farm real estate, taxes on farm estate, and, since January 1950, wages paid hired farm labor in the index of prices paid by farmers; to derive base-period prices for individual commodities, using data for the most recent 10-year period, but to retain 1910-14 period as the reference point; and to include subsidy payments and similar payments under farm programs in the "prices received by farmers" for parity computations. The Emergency Price Control Act of 1942 specified inclusion of wartime subsidy payments. An administrative determination was made that allowances for unredeemed loans and other supplemental payments authorized by Congress in the administration of price-support operations were similar to wartime subsidy payments and are to be included in parity price computations.

Calculation of Parity Prices

Under the provisions of the 1933 act, parity prices were calculated by multiplying the average price received for a commodity during the base period by the appropriate index of prices paid by farmers (parity index when on 1910-14 = 100 base). For example, the average price of corn for the 60 months August 1909 through July 1914 was 64.2 cents per bushel. The index of prices paid by farmers (parity index) for September 1933 was 116 (1910-14 = 100). Multiplying 64.2 by 116 percent gives the September 1933 parity price of 74.5 cents per bushel for corn.

This formula was modernized in 1950. Congress sought to maintain the overall 1910-14 balance between prices received and prices paid by farmers, but at the same time to have the parity prices reflect the current relationship among prices of individual farm commodities. The new formula takes into consideration price relationships among commodities in the most recent 10-year period. It uses the index of prices received by farmers on the 1910-14 = 100 base for the same 10-year period to adjust (deflate) the commodity to a 1910-14 base. The parity prices for each commodity are computed by multiplying this adjusted base price by the current month's parity index. Table 24 presents this computation step by step.

"Transitional" parity prices were used to smooth the differences in level of parity prices calculated by the old and new formulas. The transition started in 1950 for nonbasic commodities, and in 1956 for basic commodities (wheat, corn, rice, peanuts, cotton, and tobacco). Basic and nonbasic commodities are defined by legislation and the Secretary of Agriculture. By January 1965, all commodities were on the new formula. This formula, using adjusted base prices, makes it possible to calculate parity prices for new commodities—crops introduced after 1914 or commodities for which no price data were available in the 1910-14 period.

Table 24—**How a parity price is computed**

Compute:		Formula	Example (Jan. 1983 corn)
10-year average price	=	Average price received by farmers, 10 preceding years[1]	Jan. 1973-Dec. 1982 corn price = $2.48 per bu.[1]
Adjusted base price	=	$\frac{\text{10-year average price}}{\text{10-year average index of prices received (1910-14 = 100)}^1}$	Jan. 1973-Dec. 1982 prices received index = 533 percent[1] $\frac{\$2.48}{5.33} = \$0.465$
Parity price	=	Adjusted base price X current month's parity index (1910-14 = 100)	Jan. 1983 parity price = 1083 percent $0.465 X 10.83 = $5.04 per bu.

[1]Price or index includes an allowance for unredeemed loans and for other price support operations where applicable.

The 10-year period used for computing the adjusted base period moves forward 1 year at a time to keep the relationships between commodities on a current basis. Adjusted base prices are recalculated in January of each year. Regulations specify that if monthly prices are not available the adjusted base price will be determined using weighted season-average prices for the preceding 10 calendar years. Adjusted base prices are subject to revision during the year as revised monthly or season-average prices become available. Most of these revisions are made in July.

Publication and Revisions

SRS publishes parity prices for 70 agricultural commodities monthly, and 72 additional commodities in January and July, in *Agricultural Prices*. The current parity prices compiled and published at the end of a month become the legally applicable parity prices for the following month. Once a parity price is published, it is not revised, even though prices and index numbers used for the computation are subsequently revised. This policy has been followed since September 1950.

Farm Production Expenditures Survey

USDA needs information on what farmers spend for production items to calculate the prices-paid index weights, to estimate net farm income, and to estimate farmers' cost of production for crop and livestock commodities. The data are also widely used by agribusiness firms. SRS conducted the first comprehensive surveys of farm production expenditures in 1956. Annual surveys were implemented in 1972.

Data Collection

The amount of detail collected has changed frequently depending on available funds. Data on 1971 expenditures are the most comprehensive. In the three following years sample sizes were cut sharply with a corresponding reduction in expenditure detail. Sample size was then increased in 1975 and survey results published at the U.S. level and by economic class of farm. Additional funding to collect 1979 and 1980 data permitted survey results to be published for major agricultural States along with the national and regional totals and expenditures by economic class of farm. Starting with the 1982 expenditures, survey results will be published only for the 10 farm production regions and the United States. Results by economic class of farm will be published only at the U.S. level.

The multiple-frame sample design uses a list frame to estimate production expenditures for large and specialty operations, and an area frame to represent smaller operations and other operations not on the list frame. A new sample is selected each year.

The survey is designed to estimate expenditures made or incurred for agricultural production by farm operators and their landlords. Expenses associated with custom farmwork for others are included unless the custom business has no farmland or livestock and can be identified as a separate and distinct enterprise not associated with a farm operation. Expenditures by farm operators for nonfarm business enterprises are excluded.

Data are obtained by personal interview. All production expenditures for the farm, except certain ones paid by the landlord, are recorded on the operator questionnaire which breaks the expenses into about 180 categories. A landlord questionnaire is used to obtain selected expenses for the sampled farms. Expenses reported by landlords include taxes, interest, insurance, seed, fertilizer, construction and maintenance of buildings, fences, and other improvements. If the landlord pays a part of other production expenses, the farm operator is asked to report both the landlord and operator expenses.

Concepts

The costs of the variable production inputs as well as the purchase of capital asset items are included in the survey. Reporting of the variable production input expenditures generally follows the accepted procedures used in farm accounting. Respondents are asked to report only the farm share for expenditures which represent both family living and farm production such as electricity and telephone costs. Capital expenditures are reported in the year of delivery for equipment or upon completion and initial use in the case of building improvements. The entire cost of farm buildings is reported for the year in which the building is completed and the operator is using the building. For vehicles and machinery, only the difference between the cost of the purchased equipment and the allowance for trade-in (net cost) is reported. Depreciation of equipment and other capital assets is not reported. Financing charges and interest on installment purchases, delivery and installation charges, and sales and excise taxes are included as part of the total expenditure.

U.S.-level survey results are published in substantially the same detail as obtained from respondents. Less detail is provided for breakdowns of regions and economic class of farm because items are combined to achieve more acceptable levels of sampling error.

Data Publication and Reliability

A preliminary *Farm Production Expenditures Survey* report is issued in June following the year to which data relate. The detailed report with regional and economic class of farm data follows in July. Data users should be aware that these direct expansions of reported survey data are subject both to sampling errors and nonsampling errors, believed to be of about equal magnitude.

Sampling errors, shown as CV's, are published for selected groups of items. The CV is around 3 percent at the U.S. level for total expenditures and around 5 percent for the major categories of expenses reported by a high percentage of the farms.

Users should also be aware of expenditures that are grouped into a given question as well as procedures used to assure that expenses are not duplicated or reported in the wrong year. This information may be obtained from the SRS Prices and Labor Branch.

Chapter 11

Other Commodities and Activities

Introduction

American agriculture is a diverse industry with many different needs. Farmers and others in agriculture require reliable estimates for minor as well as major commodities. They also need information on a variety of elements ranging from those affecting production, such as weather and fertilizer, to those that influence costs, such as farm labor and wages. This chapter describes statistical programs for several minor commodities, selected production inputs, and cold storage reports. The associated reports are shown in table 25.

Mink

The estimated number of mink pelts produced during the marketing year, number of females bred to produce mink for pelts, number of mink farms, average marketing price, and value of mink pelts are published each July.

Estimates, begun in 1969, are based on a late March and April survey of all known mink producers. Surveys are conducted in all States, but estimates are published only for major producing States and the United States. Minor producing States are combined into an "all other States" category. Estimates are based on a nearly complete enumeration because of the small number of mink farms and the excellent cooperation and participation of producers.

The number of pelts produced during the year and females bred are classified according to the 13 basic color classes adopted by the mink industry: Standard, Ranch Wild, Demi-Buff, Pastel, Pale Brown, Sapphire, Gunmetal, Platinum, Pearl, Lavender-Hope, Pink, Violet Type, and White.

Catfish Processing

SRS started a monthly report of processing and marketing information on farm-raised catfish in January 1980. Since then, monthly estimates of the total quantity processed, inventory of processed fish on hand at the end of

Statistics on mink farms, production, and prices are published each year.

Monthly estimates of marketings and prices of farm-raised catfish began in 1980.

the month, quantity of catfish sold, and average prices paid to farmers and whole fish prices received by processing plants have been published. Estimates for the preceding month are released about the 20th of each month. Data are collected from all catfish processing plants with a capacity of 2,000 or more live-weight pounds per 8-hour day.

Cold Storage

SRS conducts a biennial survey on October 1 of each odd-numbered year of all refrigerated warehouses where food is generally stored for 30 days or more. Names and addresses are checked with trade associations, trade journals, State and Federal agencies, and others who deal with the food industry.

Surveyed operators are asked to classify their warehouse activity (public, semiprivate, and apple storage) and to report the cubic capacity of freezer rooms (0 degrees Fahrenheit or lower) and cooler rooms (above 0 degrees Fahrenheit). After followups to reach nonrespondents, survey data are summarized into city, State, and national totals by cooler and freezer classifications for each type of activity.

Monthly Cold Storage Report

Monthly inventories shown in the *Cold Storage* report are stocks immediately outside the retail pipeline. They include inventories in refrigerated facilities artificially cooled to 50 degrees Fahrenheit or lower that generally hold food items for 30 days or longer. SRS does not estimate "working stocks" in refrigerated facilities owned and operated by wholesalers, jobbers, distributors, locker plants, chainstore warehouses, and similar types of businesses that generally hold food products fewer than 30 days. Excluded, too, are food supplies in refrigerated warehouses owned and maintained by the Armed Forces. However, the SRS cold storage inventory includes any stocks stored by the military in public warehouses. Data for the *Cold Storage* report come principally from:

- Public general warehouses that charge for storing food belonging to others;
- Private general warehouses used by producers, manufacturers, or processors for storing their own production but not accepting food commodities belonging to others;
- Semiprivate general warehouses used by producers, manufacturers, or processors for storing their own production and food commodities belonging to others;
- Apple or fruit houses—public, private, or semiprivate facilities used principally for storing apples or pears.

Questionnaires are sent from each SSO about the 23rd of each month to all refrigerated warehouses on the mailing list. Excluded are those warehouses storing only fish and reporting directly to the U.S. Department of Commerce, fruit warehouses closed for the season, plants in which stocks are consolidated into a single report from corporate headquarters, and warehouses whose stocks are reported directly to a State or other government agency that has responsibility for collecting and reporting refrigerated food holdings.

The monthly questionnaire asks for end-of-month warehouse inventories of more than 100 fresh and frozen fruit and vegetables, nuts, dairy products, juices, poultry, and meats. Public warehouses also report on the degree of use of their cooler and freezer space. This provides the public with an index of availability of storage space on a city, State, and national basis.

The monthly *Cold Storage* report provides regional and national totals of the various food items in storage. Stocks of apples are also published by major producing

Early Allegations

Early in the century, allegations that cold storage warehouses were being used by some speculators to corner food supplies and drive up retail prices prompted a lengthy investigation by USDA. The Secretary of Agriculture recommended in 1911 that buyers, sellers, and the public be informed of the quantities of food in storage through monthly reports. The program has grown to include more than 100 different food items since the first report on apples in storage in 1914.

The food warehousing industry reports its inventories voluntarily each month; only during World Wars I and II was reporting mandatory, because of limitations placed on the use of refrigerated space for less critical food items.

States. Although there is a high response rate to cold storage survey questionnaires each month, any large and specialized units not responding are contacted by telephone. For warehouses that fail to report by the cutoff date, SRS makes estimates of stocks based on C/C ratios of month-to-month change indicated by those warehouses that reported. Stocks data are collected and edited by each SSO and summarized in Washington, D.C. Preliminary estimates are then made for the monthly *Cold Storage* report. Preliminary estimates are revised for the next monthly release by substituting late-arriving data for stocks in warehouses estimated by SRS.

Special Surveys

Special surveys in January, March, and November provide a national summary of strawberry stocks by retail and institutional containers. Warehouses report their inventories according to package size. Only total inventories are reported at other times. Tree-nut stocks, in shell and shelled, are reported for two categories—pecans and "other nuts"—on each monthly questionnaire. In June, warehouses are asked to provide their stocks of "other nuts", in shell and shelled, separately for almonds, filberts, and walnuts. The national summary is based on estimating procedures similar to those used for other commodities reported monthly.

Annual Reports

In March, revised monthly estimates of food stocks for the previous year are published in the *Cold Storage Annual Summary*. Revisions occur monthly during the year because of late reports, reporting errors, inclusion of stocks from new cold storage facilities, and deletion of estimated stocks in plants going out of business but not detected during the year. These corrections, additions, and deletions constitute revisions in the report. Annual report data are not further revised.

Farm Labor and Wage Rates

SRS has provided farm employment estimates since 1909 and farm wage estimates since 1866. From 1909 through 1924, aggregate estimates of farm employment consisted of annual averages for the Nation. From 1925

Table 25—**Calendar of other reports**

Report	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Catfish												
Processors' reports on farm-raised catfish products purchased, price paid, inventory, quantity sold, and price	●	●	●	●	●	●	●	●	●	●	●	●
Cold Storage												
End-of-month stocks on hand of meats, dairy products, poultry products, fruit, nuts, and vegetables	●	●	●	●	●	●	●	●	●	●	●	●
Cold Storage Annual												
Regional and national totals			●									
Commercial Fertilizers												
Annual consumption estimates											●	
Farm Labor												
Family and hired employment on farms and wage rates								●				
Mink												
Number of pelts produced and females bred by color class; price and value included only for United States							●					
Weekly Weather and Crop Bulletin												
National and international weather and crop conditions	(weekly)											

through 1933, monthly estimates were published for the United States. Regional breakdowns were provided starting in 1934 and monthly estimates by State began in 1950. In January 1975, with the introduction of survey methods using probability sampling, quarterly estimates replaced monthly estimates. Quarterly estimates were dropped following the April 1981 survey and an annual survey was reinstated in July 1982.

Wage Rates

Annual average wage information was issued intermittently beginning in 1866, and annually from 1909 through 1922. From 1923 through 1947, wage rate estimates were published quarterly for daily and monthly wages. Beginning in 1948, wage rate estimates were published quarterly for hourly, daily, weekly, and monthly wages. This series provided wage information by nine categories: per month with house, per month with board and room, per week with board and room, per week without board and room, per day with house, per day with board and room, per day without board and room, per hour with house, and per hour without board and room.

Starting in 1974, wages were collected by method of pay including per hour for piece rate, other than piece rate, hourly rate (perquisites provided), cash wages only (any method of pay but no perquisites provided), and wages per hour (no perquisites). Pay categories were modified in 1982 to make the series more analogous with wages reported in other industries. Wage rate breakdowns reported are for workers paid strictly on an hourly basis, on piece rate converted to an hourly wage rate, and other methods of pay converted to an hourly basis.

Many workers work more than one job, but the respondent classifies the workers according to how most of the time was spent during the survey week. This information is used to compute wage rates published by type of work. Starting in 1974, wage rate groupings reported were field and livestock, packinghouse, machine operator, maintenance and bookkeeping, and supervisor. Maintenance and bookkeeping workers were included as other agricultural workers beginning in July 1977. Also in 1977, the field and livestock worker series was divided into a field worker wage rate series and a livestock worker series. Wage rate breakouts by type of work performed were limited to field, livestock, supervisory, and others starting in 1982.

The average numbers of hours worked during the survey week by farm operators, other unpaid family members, all family members, hired workers, and all workers were published for the Nation and by States for 1965 through 1981. The family workers other than the operator were considered other unpaid family members and had to work 15 or more hours during the week. Starting in 1982, the categories of farm and unpaid family members were changed to self-employed and unpaid workers to conform more closely to data series in other business sectors.

Data Collection

A nonprobability mail survey was the primary data collection method for both farm labor and wage information prior to 1975. SRS implemented a quarterly probability survey based on the multiple-frame sampling concept in January 1975. This sample provided more reliable data by assuring that large and specialized labor users were adequately represented and estimates of sample variation could be calculated. From 1975 through April 1981, the quarterly (January, April, July, and October) survey data were based on reports from about 16,000 scientifically selected farms. The annual survey began in July 1982 with the sample reduced to obtain about 8,000 reports.

Since 1975, farm employment and wage rate estimates have been for the week that included the 12th of the month. This corresponds to the week specified in general employment and wage series of other Government agencies. In the nonprobability approach (prior to 1975), farmers were asked to report employment for the last full week of the month and prevailing wage rates for the first of the month in their localities. The current survey questionnaire requires that workers must have been employed on the farm during the survey week. Workers will be counted more than once if they worked on two or more farms during the survey week. However, the number of hours worked and wages earned are not duplicated.

Self-employed workers are defined as the operator and others who work on the farm without pay, but share in the returns from the farm. This concept was adopted in 1982 to provide data users with an agricultural series analogous with other industrial series. Only one person could be designated as the operator of a farm or ranch prior to 1982. With the adoption of the self-employed category, all active partners working on the farm are counted as self-employed, whereas in the past only one was counted as the operator and the others were listed in the unpaid family category. Self-employed workers are counted if they work at least 1 hour during the survey week. Unpaid workers must work at least 15 hours or more to be counted.

Hired workers include both family members and other workers who are paid for working on agricultural jobs for 1 hour or more during the survey week. Statistics on workers hired to perform an agriculturally related service on the farm or ranch are available for the Nation, California, and Florida from July 1978. These workers are paid by a crew leader or agricultural service firm hired by the farm or ranch operator to perform specific tasks.

Setting Estimates

Direct expansion of the survey data provides indications used for setting estimates. Time-series relationships are maintained to detect unusual situations that may affect the estimates. Weather conditions and work activities during the survey week are also considered. Gross wages are divided by hours worked for all methods of pay to derive an hourly rate. The amount paid to employees is that before any deductions for taxes, insurance, or other benefits. A value is not placed on perquisites provided, such as housing, room and board, or transportation.

Data Reliability

Coefficents of sampling variation (CV's) can be computed with probability sampling techniques. CV's for State estimates of the number of hired workers, self-employed, and unpaid workers range from 10 to 20 percent. CV's for hired, self-employed, and unpaid workers are less than 6 percent at the national level. Wage rate CV's are 5 percent to 10 percent at State level and 2 percent to 4 percent for published regions and the United States.

Number of Farms and Land in Farms

The SRS series of farm numbers estimates dates from 1910; estimates of land in farms began in 1950. From 1840 through 1910, enumerations of farm data were made in connection with the 10-year population census.

Annual estimates of farm numbers and land in farms are published in the August *Crop Production* report. These include estimates for the current year and revised estimates for the previous year. Estimates are based mostly on the results of the JES. The different indications—direct expansions and ratio estimates of "open," "closed," and "weighted" segment data—are plotted on time-series charts for each State, region, and the United States. The 5-year Census of Agriculture estimates are also included on the charts.

> What is a Farm?
>
> USDA and the Bureau of the Census use the same farm definition, although that definition has changed over the years. Definition changes are timed to coincide with years when the U.S. Census of Agriculture is taken.
>
> From 1955 to 1974, places were classified as farms if they had 10 acres or more and sales of $50 or more or had sales of $250 or more without regard to acreage. In 1975, places had to have sales or expected sales of $1,000 or more without regard to acreage to be classified as farms. This change in definition resulted in about 9 percent fewer farms in 1975 than would have been included by using the previous definition.

The open segment (farm) direct expansions of resident farm operators and the closed segment (tract) direct expansions of all land in farms are the primary indications used to determine national estimates of farm numbers and land in farms. Estimates of farm numbers and land in farms are determined first at the national level, then at regional levels, and finally at State levels. The average size of farms is derived by dividing the estimates of land in farm by the number of farms.

Estimates of the number of agricultural operations selling milk or reporting hogs, cattle, or chickens are considered when estimating farm numbers, especially at the State level. The estimates of number of farms and land in farms are reviewed whenever data from the Census of Agriculture become available. Consideration is given to comparisons with previous census results, changes in census survey procedures, and results of the census quality check that determines the extent of incompleteness or double coverage.

Fertilizer

"Fertilizer consumption" is an industry term describing the amount of fertilizer moving through various points in the supply chain from producers to retailers. Except for some minor carryover of fertilizer by growers, these consumption estimates closely correlate with the amount applied to crops and other vegetation.

Fertilizer consumption statistics were begun in 1850 by the Bureau of the Census and were published there until 1910. From 1911 to 1933, annual statistics were compiled by the National Fertilizer Association. USDA's Ag-

ricultural Research Service handled the task from 1934 through 1965, when the responsibility was transferred to SRS.

SRS now publishes "fertilizer consumption" tonnages annually. The tabulations are based on reports from State fertilizer control officials, manufacturers, blenders, and sales outlets. Laws in 47 States require various levels of the industry to report fertilizer tonnages at some point in the pipeline. Currency of the data and the period covered by the reports vary significantly from State to State. Tonnages reported by State control officials are generally adopted by SRS for those States with complete programs. A survey of manufacturers, distributors, and blenders is used to supplement the State control official data for States with less complete programs and is the main basis of estimates for those States without control officials.

The annual release in November covers all States and Puerto Rico for the year ending June 30. The publication includes estimates by States on fertilizer mixtures, direct application materials, primary nutrient tonnages of major materials, total organic materials, and secondary nutrient and micronutrient materials. The estimates are reviewed the following summer after more complete data are available and revised estimates for the previous year are published as required in the November report.

Weekly Weather and Crop Bulletin

The Weekly Weather and Crop Bulletin, published jointly by SRS and the National Oceanographic and Atmospheric Administration, U.S. Department of Commerce (NOAA), emphasizes the cumulative influence of weather on crops throughout the United States. Weather conditions affect important farming operations such as planting and harvesting, and greatly influence yield at critical stages of development. The bulletin provides timely weather and crop information between regular monthly *Crop Production* reports and also for the period between a crop report survey reference date and the release of the official estimates.

Origins of today's weather and crop reporting service lie in a pilot project undertaken by the Smithsonian Institution about 1845. The Smithsonian supplied special observational equipment to a network of cross-country telegraph operators who relayed weather data back to Washington. The Smithsonian project was given to the U.S. Army's Signal Service in 1870, and 2 years later that group issued the first *Weekly Weather Chronicle*. The bulletin, published since that time, has undergone several name changes and has had several publishers in the intervening years, as responsibility for civilian weather services shifted from the Army to USDA, and then to the Department of Commerce. The present *Weekly Weather and Crop Bulletin* summarizes weather and crop information supplied by thousands of people in all parts of the Nation. Respondents include about 3,000 USDA county extension agents, NOAA meteorologists, and thousands of weather observers and SRS crop reporters.

Each Monday, during the growing season for most States (year-round for several States), SSO's summarize the previous week's crop progress information sent in by county agents and crop reporters. At the same time, NOAA meteorologists in designated weather offices in each State (or State climatologists in a few States) summarize weekly weather observations received from rural observers and urban weather stations.

The detailed weather and crop summaries are combined and released to the public by the SSO's each Monday afternoon in State weekly weather and crop bulletins. A brief telegraphic advance report of this summary information is transmitted to the crop statistician at the NOAA/USDA Joint Agricultural Weather Facility in Washington, D.C. There, a team of weather experts and an SRS crop statistician study the State reports along with weather and agricultural narrative summaries. At 4:00 p.m. on Monday (April through December) an advance report is released showing information on percentage of important crops planted or harvested, and percentage of crops in various phenological stages (such as silking of corn or heading of wheat). Comparisons with previous year and 5-year averages are indicated also. The agricultural summary usually discusses small grains (primarily wheat), corn, cotton, soybeans, other field crops, vegetables, fruit, nuts, pastures, and livestock.

National summaries are released to the news media at noon each Tuesday. The *Bulletin* itself, which includes the national summaries, State telegraphic reports, crop progress tables, various charts and tables, and world weather and farm news is printed and mailed to subscribers.

The *Bulletin* includes U.S. maps and tables showing the week's total precipitation and departure of average temperature from normal; monthly and seasonal tabulations are published periodically. Soil moisture conditions, growing degree-days, depth of snow on the ground, soil temperatures, pan evaporation, and heating degree-days are presented in the appropriate seasons.

Available temperature and precipitation data from other major crop production areas of the globe are also presented, usually in map form, along with weekly descriptions of weather affecting crops. Summaries of progress and conditions of principal crops for major regions and countries around the world as developed by USDA's World Agricultural Outlook Board and NOAA meteorologists are also included.

Pasture and Range Condition

The monthly *Crop Production* report (April through November) indicates the current grazing condition on nonirrigated pastures and ranges thoughout the 48 conterminous States. The April report covers only 37 States. Excluded are the New England States, New York, Pennsylvania, Michigan, Wisconsin, and Minnesota.

The monthly indication of condition is obtained from a general survey of farmers and ranchers. SSO's derive straight and weighted average conditions for each county and crop reporting district. State-weighted average conditions are used to derive a national average condition.

The condition percentages are rated as follows:

Percent of normal	*Rating*
Under 35	Extreme drought
35–49	Severe drought
50–64	Very poor
65–79	Poor to fair
80 or more	Good to excellent

State maps of county averages and isocondition lines are also prepared each reporting month by SSO's. A U.S. map is published showing national pasture and range conditions.

Chapter 12

Research

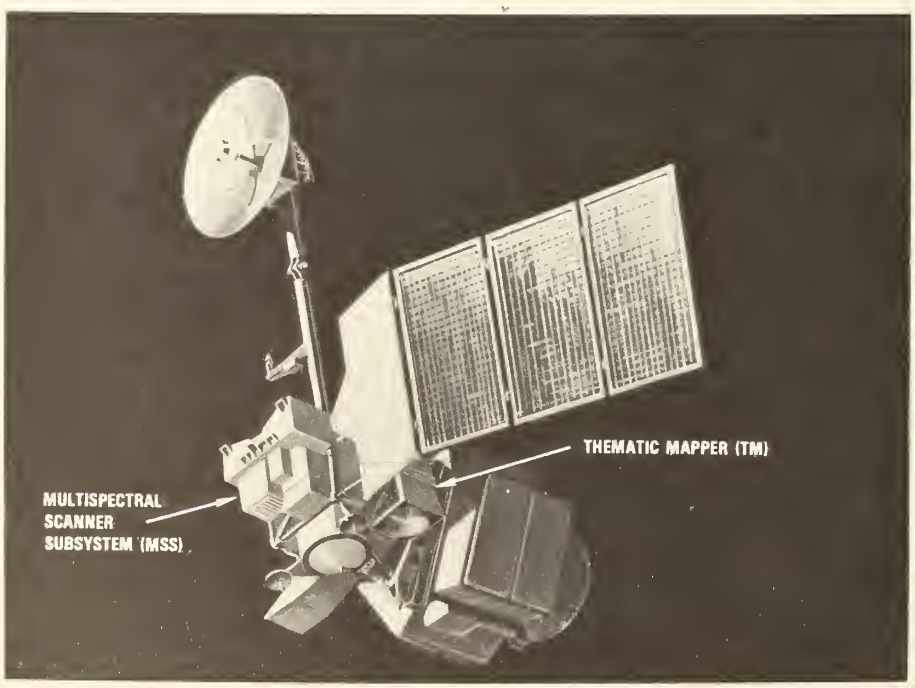
Introduction

Research has been a formal SRS activity for more than 25 years. SRS continually conducts research aimed at improving the quality of crop and livestock estimates. This chapter describes the principal areas under study: remote sensing, crop-yield forecasting and estimation, sampling frames, and survey research.

Remote Sensing Research

Remote sensing research is the study of imagery or digital data collected from aircraft or spaceborne sensors to detect valuable information about conditions and resources on the earth's surface. SRS has been a user of remote sensing products since the fifties when it began using aerial photography to construct area sampling frames. Thus, since the fifties, SRS has had an intense interest in being familiar with and using the most cost-effective photographic products available for its purposes. As described in Chapter 2, SRS presently uses aerial photography mosaics to stratify broad land use and rectified aerial photographs to collect data from farm operators.

Numerous research efforts were conducted in the sixties and early seventies by SRS and other research institutions such as the National Aeronautics and Space Administration (NASA), Purdue University's Laboratory for the Application of Remote Sensing, the Environmental Research Institute of Michigan, South Dakota State University's Remote Sensing Institute and the University of California at Berkeley's Remote Sensing Research Program. These projects investigated the potential of aerial photography and aerial multispectral scanner data (digital energy readings) to meet SRS information needs. Topics addressed were diverse and included tree counts, fruit counts, livestock counts, and measuring the effects of corn blight. This previous research by SRS and other research institutions and the use of its area sampling frame procedures put the agency in a position to address the research needed for domestic crop estimation after the launch of NASA's first earth-resource monitoring satellite, Landsat 1, in 1972.



Artist's rendition of Landsat 4 satellite in space, showing the multispectral scanner and thematic mapper. These devices sweep the earth's surface, measuring reflected energy. Scientists are learning to use satellite data to better estimate crop acreage.

Landsat Satellites

Four Landsat earth-resource monitoring satellites, launched since 1972, have collected digital information on the amount of energy being reflected, emitted, or absorbed by the earth's surface. The major measuring instrument on Landsats 1, 2, and 3 was a multispectral scanner (MSS) that measured energy in four bands of the electromagnetic spectrum every 18 days for approximately each acre on the earth's surface. Landsat 4's new measuring instrument, the thematic mapper (TM), takes measurements in 7 bands every 16 days for approximately each one-fourth of an acre. Landsat 4 also has an MSS on board that provides 16-day coverage.

Since the launch of Landsat 1 in 1972, SRS has investigated the potential contribution of earth-resource satellite data to its domestic crop acreage estimation program. SRS's operational use of area sampling frames already provides a statistically sound and cost-effective crop acreage estimation program even without Landsat data. Thus, the integration of Landsat data has had to show potential for improving the statistical reliability of an already sound program. In the last 10 years, SRS has developed two major uses of Landsat data. The first is photo-interpretation of imagery from Landsat MSS and the return beam vidicon (a second sensor on board Landsats 1, 2, and 3) for broad land use stratification in constructing area sampling frames, as explained later in this chapter. The second major use of Landsat MSS data is to classify the digital data into crop types and regress SRS ground-collected data against the classified Landsat data for each crop type. The degree of success of these improved crop acreage estimates depends heavily on optimum timing of Landsat coverage, the extent of cloud cover, and the rapid delivery of Landsat data to SRS.

Methodology used by SRS in its domestic crop estimation program is described in Chapter 2. One major survey used for crop area estimation is the June enumerative survey (JES). The use of Landsat data for crop area estimation has been an extension of the JES. The JES provides data collected for a random sample of area segments. Landsat measures energy for each acre on the earth's surface. A statistical relationship, called a regression estimator, is developed between the ground-gathered data and the satellite energy readings.[2] The measure of success associated with this probability-based estimator is referred to as the relative efficiency (RE).

[2] See John Cochran, *Sampling Techniques*, third edition, John Wiley and Sons, 1977, pp. 189-199.

RE, or success, is defined as the multiplier that would be necessary to increase the sample size of the JES in order to obtain an estimate just as precise from the ground data alone as from the ground data plus Landsat. For example, there are 435 JES segments in Kansas. If the JES plus Landsat regression estimator has an RE of 2.0, then it would have taken 870 JES segments to obtain the same precision from a ground data only (direct expansion) estimator. Major research studies were conducted from 1972 to 1978 to determine the applicability of the regression estimator for large-area crop estimates. RE's generally ranged from 1.5 to 5.0. Based on this research, researchers concluded that it was indeed feasible to prepare large-area crop estimates through joint use of JES and Landsat data. Since 1978, in selected areas, the research results have been calculated on a timely basis and used as an indicator for the CRB's annual crop summary.

Specialized software and computer hardware were necessary to process the Landsat and JES data jointly. Starting in 1974, SRS and the University of Illinois' Center for Advanced Computation entered into a joint agreement to redesign a software system for this purpose. The system (EDITOR) was redesigned to analyze SRS's ground-gathered data and Landsat data and to calculate the regression estimates. Data processing was to be done at several locations using several computer systems and telecommunications networks. The Illiac IV supercomputer at NASA's Ames Research Center was used by SRS from 1974 to 1981 to classify the 10.5 million picture elements ("pixels") on a Landsat image into the selected crop and land cover types. Currently, SRS uses the CRAY-1S supercomputer for this task at the Ames facility. In 1983, SRS plans to process a volume of Landsat data equivalent to the amount of data collected for 75 national JES's.

AgRISTARS Program

Starting in 1979, SRS research became a focal point of the Agriculture and Resource Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS) research program. AgRISTARS is a 7-year interdepartmental research program designed to evaluate the potential of aerospace remote sensing data to meet many USDA information needs. The program was initiated by USDA and includes as partners NASA, the U.S. Department of Commerce, and the U.S. Department of Interior. Multi-agency teams of scientists were assigned to eight major project areas: early warning and crop condition assessment, foreign commodity production forecasting, yield model development, domestic crops

and land cover, renewable resources inventory, soil moisture, conservation and pollution, and supporting research.

SRS has overall management and coordination responsibility for the AgRISTARS Interagency Coordinating Committee and the Program Management Team. Within the structure of the interagency AgRISTARS research program, SRS assumes leadership for the Domestic Crops and Land Cover project (DCLC). SRS also has a supporting role in several of the seven other project areas.

The goals of the DCLC project are: to calculate timely and more precise crop area estimates at the State and substate level, using Landsat and SRS's JES data jointly in an expanding number of States; to conduct research on new methodology and on data from new satellite sensors and on ADP to process and analyze the Landsat and JES data; and to conduct research on land cover area estimation and mapping.

In early 1983, AgRISTARS was restructured and reduced from eight to three major projects: domestic commodity assessment research, foreign commodity assessment research, and land resources monitoring research. SRS maintained leadership of the domestic commodity assessment research and overall AgRISTARS management. The work done in the DCLC project continues under the domestic commodity assessment research project.

Land Cover Research

In 1979, land cover was a completely new area of interest for SRS remote sensing research. The concentration before had always been on estimates of crop areas only. The DCLC project gave SRS a research charter to evaluate and develop techniques which might answer information needs of other USDA agencies or State and county-level agencies concerned with natural resource management. NASA's National Space Technology Laboratory (NSTL) had prior experience in examining land cover and geographic information needs of other USDA agencies as well as State and local agencies. Thus, SRS and NSTL personnel began joint remote sensing research efforts in 1980 to address land cover information needs.

The first technique that SRS chose to explore for statistically based land cover estimation was an extension of the JES, and JES-plus-Landsat, estimators. Since the JES sample was allocated mainly for crop and livestock estimation, some additional nonagricultural strata segments were added to the JES sample in Kansas to gather information on the basic land cover definitions.

The SRS requirements for land cover research are that any estimates created must be statistically sound estimates and any map products created must have statistically sound measures of accuracy.

Remote Assessment of Worldwide Crop Yields and Conditions

SRS is taking part, with the Agricultural Research Service (ARS) and Foreign Agricultural Service (FAS), USDA, and the National Oceanographic and Atmospheric Administration (NOAA) in the AgRISTARS program under the domestic commodity assessment research project in the development of remote assessment methods to measure crop yields and monitor crop conditions in the United States and other countries. The methods being researched rely on inputs from many sources including weather data as reported through existing domestic and foreign sources, published material on cropping practices, satellite remote sensing data, analysis of the effects of changes in government programs and evaluations of the extent of disease and pest problems. Mathematical models bring together the effects of combinations of these inputs to provide condition or yield values which can be interpreted alone or in a time series with previous data.

Research has been under way since the outset of the AgRISTARS project, and several methods developed are being used operationally by FAS. The primary areas of application, outside the United States, are for the major countries that produce or import crops produced by the United States. Two major crops of interest are wheat and soybeans or their substitute crops. Countries of interest are the U.S.S.R., People's Republic of China, Brazil, and Argentina.

In the United States, data are collected, analyzed, and published on a current basis in direct support of yield and condition assessment. This is not the case for many foreign areas. Remote assessment is thus complimentary to other domestic data collection sources and is a primary method for independent assessment over foreign areas. In the United States, such methods could prove useful to obtain yield information for States not included in the objective yield programs and for crops not having objective yield surveys.

Even though there are many similarities between condition assessment and yield estimation there are some differences. Condition assessment relates measures of the current year with similar measures in previous years, or previous points during a given growing season, whereas yield estimation would produce a point value that would "stand alone" without previous data.

Developing crop yield models relating factors that seem to affect production, such as weather events, is not a new endeavor. SRS and its predecessor agencies have been involved in the development and use of weather-yield regression models for some time. What is new about the current effort to develop and use these models is their application to forecasting crop yields in foreign production areas and their reliance on remote sensing. Large-scale use of such models is now possible using advanced computers and improved statistical techniques.

Researchers have developed a set of criteria to evaluate proposed crop yield models for use by USDA agencies. Evaluation of candidate models, in terms of their ability to "measure up" against these criteria or desirable characteristics, also helps model developers to improve the models and to identify those models which are the best candidates for further research. The eight criteria currently emphasized in model evaluation and comparison research are: yield indication reliability, timeliness of model output, minimum cost of model operation and development, the provision of accurate current measures of modeled yield reliability, objectivity, consistency with scientific knowledge, adequacy of geographic coverage and detail, and simplicity.

Crop yield model development must assess both the short-and long-term factors which influence yield levels. The plant process model, discussed elsewhere in this chapter, attempts to explicitly account for important factors of both types. However, to the extent this is not fully achieved, either because of model limitations or limited data availability in many foreign areas, the plant process model may need to be calibrated over a period of years or by location to the observed or reported yields. Somewhat simpler models, which are designed to reflect more general relationships of a crop's yield to the plant's environment, are being developed from a time series of yield and environmental data.

In condition assessment, SRS participates with scientists from ARS, NOAA, and NASA to develop methods with particular reference to early warnings of events that may substantially affect crop yield. This research is aimed at providing USDA agencies having responsbility for foreign and domestic production forecasting, with a timely capability to monitor crop development and those conditions affecting production potential. Some of the products developed may also have application in the SRS input to the weekly weather and crop program. Among the techniques being studied are models to provide alarms for potentially damaging ambient conditions, including water and temperature stresses, the prediction of insect epidemic, and plant stress caused by flooding.

Look to the Future

In the eighties, the researcher may be able to make use of aerospace data from a variety of sources. At the same time, costs may be greater and some basic limitations of satellite data remain to be hurdled. As new sources of aerial photography or satellite imagery become available, SRS personnel will evaluate their potential for cost-effective improvements in constructing area sampling frames. Potential sources are as follows: the Government's national high-altitude photography (NHAP) program, MSS and TM image products from Landsat 4 and D′ (which will be identical to Landsat 4), the large-format camera on future space shuttle missions, and the French "SPOT" satellite image products. The major problems to be resolved are the cost and geometric rectification of these products.

The second major use of Landsat data by SRS is the use of digital data for crop and land cover area estimation and crop yield assessment. Potential future sources for this digital application are: both MSS and TM data from the Landsat 4 and D′, French SPOT data, and any future private-sector Landsat MSS, TM, or new sensor missions. Research results from TM simulator data over Missouri in September 1979 indicated that the increased TM resolution will improve the efficiency by a multiplier of two to three over MSS for major crop area estimates.

Major concerns of SRS regarding future applications that use spaceborne data are as follows: frequency of satellite data coverage during short (1-month) "optimum windows," the cost of "one scene" of satellite data, rapid delivery of satellite data to SRS, and the total project cost. Using 1982 cost estimates the RE of the regression estimator should be 2.5 or larger for a cost-effective improvement in statistical precision. The SRS research results from 1975 to 1982 have been mixed concerning cost-effectiveness. The majority of results have met the criterion of the cost-effective improvements in precision. However, the increased cost of the new and

higher resolution data and the associated data processing costs will be a major concern. The frequency of cloud-free images (coverage) is a serious operational problem at this time. The need for cloud-free coverage for at least one pass during the relatively short (approximately 1-month) optimum temporal windows for crop-area estimation is a critical need of SRS. A 9-day interval is the preferred minimum satellite configuration to ensure this coverage for any operational SRS domestic crop area estimation program that uses satellite and JES data. At present, the Landsat program provides 16-day coverage. Also, the 21-day target average for data delivery needed by SRS for Landsat data and images has never been met for any SRS full-State project. Twenty-one day turnaround for products is essential for future SRS projects. However, NOAA plans to provide Landsat MSS data to users in 12 to 27 days in the near future.

Completing research and development required to extract agricultural statistics information from MSS data took several years. It is expected that the same will also be true for the new higher resolution sensors. However, the research and development time period is expected to be somewhat shorter due to the presence of experienced statistical, data processing, and remote sensing staff. As with the MSS, however, the potential information content is significant, and the eighties will be a decade of exciting research on these new sensors.

Crop Yield Forecasting and Estimation

The Research Division develops and improves objective methods of estimating and forecasting yields for a wide variety of crops. The estimation of crop yields at harvest and forecasting of yields during the growing season are two distinct phases of this research. For most crops, the development of methods of estimating harvesting losses constitutes an additional phase.

Objective Yield Surveys

SRS has a continuing program of research to improve operational objective yield forecasts and estimates and to reduce the cost of data collection. In addition, research is underway to develop new objective yield surveys for rice, grain sorghum, and sunflower. As technology and cropping practices change, SRS researchers conduct field studies on objective-yield crops to evaluate the size and number of plots needed for sample fields, the relationships in the forecasting models, and procedures used for obtaining counts and measurements. They also observe the plant growth characteristics of new crop varieties.

Another form of research, the validation study, tests for overall levels of bias in objective yield procedures. Researchers compare the yield, calculated from a large number of plots harvested in a field, to the actual weighed production the farmer harvests.

Development of objective yield procedures for new crops begins with a trial adaptation of existing procedures for estimating yields. Literature on crop development characteristics suggests which plant characteristics would be most useful to count and observe. Procedures are modified based on pilot studies in one or more States, and historical data are accumulated to construct forecasting models. Developing reliable estimating and forecasting procedures generally takes 3 or more years.

Plant Process Models

A plant process model (PPM) is a computer simulation of plant growth. Most models simulate the day-by-day growth of a plant by calculating the effects of management variables (such as plant density and cultivar), soil properties and initial soil water, and real or hypothetical daily weather conditions. The models ultimately estimate gross grain yield of a typical plant in a homogeneous plant community.

SRS is researching the feasibility of ultimately using PPM's to produce more timely and accurate yield forecasts based on growing conditions during the current crop year. This presupposes that a model could accurately mimic (or model) plant growth with minimal data requirements.

Many computer simulation models of plant growth developed by agricultural scientists have been used to manage water resources, diseases, pests, and other factors affecting crop yield. Yet no PPM has been extensively validated for a wide geographic range of growing conditions. Needed techniques are still being developed and refined, and data required for an extensive validation would be substantial.

SRS objective yield forecasts assume that historic regression relationships—usually for the most recent 3 years—will continue for the current year. However, if environmental conditions for a given crop year are unlike those during the previous years (or if they are but the regression fit is not particularly good), the forecast may be somewhat inaccurate. Since PPM forecasts are

PPM's Potential

Current plant process models are still in the developmental stage and require far too much data to be used for crop forecasting. However, assuming that reliable models for SRS applications were developed, the data problem could be overcome. Electronic monitors might be developed to record the weather and possibly plant water and nutrient stress in every sample field of an objective yield survey. It also might be possible to interpolate the daily meteorological inputs from the nearest weather stations. A central computer could then poll the sites remotely to acquire data for model operation. Using the PPM, the computer would simulate the yield for each site and then average yield over all samples to make a forecast or estimate.

based on conditions in the current year, and not on past relationships, they are potentially more accurate and reliable.

SRS is doing extensive sensitivity analysis research on PPM's. Sensitivity analysis is the application of statistical techniques to a computer simulation model to determine the relative importance of input variables, internal subroutines, parameters, and functions of the model. This technique determines the model's internal consistency, whether or not all variables and parameters are required, and how accurately input variables need to be estimated. A variable necessary to run a PPM but not crucial to the accuracy of the yield forecast would not need to be collected with great precision. This could reduce data collection costs.

Since a PPM must know weather data for an entire growing season in order to simulate yield, simulated or estimated future weather from a current forecast date to harvest would have to be externally supplied. A weather simulator (discussed later) could be used to generate future weather inputs for each location. Such a simulator would make it possible to produce several alternative crop forecasts each month, for example, assuming normal, favorable, or unfavorable weather.

Another approach to obtaining the information required by a PPM would be to use satellites to estimate air and canopy temperature, solar radiation, and soil moisture. Research in this area is underway, and both temperature and solar radiation test models are available for evaluation. This would be useful for a model in the "middle ground" between a very detailed PPM and the aggregrate-level modeling such as a regression of county yields on average monthly precipitation and temperature. Another approach being considered is to improve the accuracy of current objective yield techniques by incorporating PPM techniques.

Weather Simulation

Most PPM's require daily weather for the entire growing season as an input to forecast yield. The most commonly needed weather variables are daily precipitation, maximum and minimum temperatures, and solar radiation. Research in weather simulation has, therefore, been directed toward generating possible sequences of these variables. These sequences are not forecasts of the weather, but simulations of possible real weather events. The simulations can be used to forecast yield when current data are not available, but more important, they can be used to evaluate the effect of various weather sequences on yield.

One of the earliest procedures for simulating weather used empirical frequency tables to determine probable weather values. For example, the amount of precipitation was calculated based on the frequency of precipitation amounts once the amount of precipitation on the previous day had been determined. This method required frequency tables for each weather variable, at each location, for a specified time period. More recent simulation models assume that the weather variables come from specific statistical distributions. For example, the amount of precipitation comes from a gamma distribution; temperature is expressed as two bivariate normal distributions; and solar radiation is described as a gamma or beta distribution depending on whether it is raining. These distributions are assumed to hold at all locations, while the specific parameter values for the distributions vary from location to location. Parameter values can be easily estimated for each location for an entire year provided historic data are available.

Production Inputs

In order to accurately forecast crop yields, statisticians must know how farmers' production practices change from one year to the next, and how such changes are likely to affect yields. SRS researchers are developing techniques to explain variations in crop yield caused by changes in farm production practices. Lacking such knowledge, previous yield models used to forecast crops relied on a time trend or proxy variable to explain yield increases over time, and they focused on yield variations

Portable Data Entry Devices

The SRS enumerator, who gathers data in person, may one day arrive at the farmstead holding a hand-held computer instead of the traditional pencil and questionnaire. New hand-held computers called portable data entry devices (PDE's) make it possible for the enumerator to collect and record data and transmit it directly to a computer for editing and summarization. These devices have the potential for eliminating the lapse of time between data collection and processing and for enhancing communication and quality control during a survey. Current state-of-the-art devices weigh between 1 and 6 pounds; most are powered by rechargeable batteries. The user enters data with keys similar to those on portable calculators. A character display shows the data being entered or prompts the surveyor for the next question with keywords such as "acres?" Later, the PDE transmits results to a computer by "talking" through a telephone hookup. Some PDE's can be programmed to promptly edit the data entered to ensure reasonableness before transmission.

Research in SRS is just starting to explore the use of these devices. The first field test is being planned and required communications links established. Pilot testing will begin in the near future.

caused by weather. Today, SRS yield forecasting and estimating models take some account of changing production inputs along with more refined estimation of weather effects. But, much remains to be learned about the effects of these inputs.

Techniques are being researched to measure and estimate changes in the available soil plant nutrients, yield potential of genetic seed stock, yield losses from pests, and changes in the type and timeliness of tillage systems. Researchers also are developing procedures to integrate these estimates into crop yield models. This research makes use of field test results reported by plant scientists and surveys of farmers' production practices.

Crop forecasters need to know how levels of plant nutrients change from year to year. Present objective yield surveys estimate the proportion of crop acres receiving commercial fertilizer and the quantity of primary nutrients applied to corn, soybeans, wheat, and cotton. These commercial fertilizer measurements, however, do not account for potential yield effects due to the natural fertility levels of soils, potential carryover of nutrients from fertilizer applied in the past, crop rotation, or the effect of various tillage systems. Investigators are looking into alternative techniques to estimate soil nutrient changes and yield responses, potentially useful in yield models.

New hybrid or variety seeds have contributed dramatically to yield increases. SRS routinely surveys major States to estimate the percentage of acres planted to specific varieties for wheat, soybeans, barley, and other crops. Results of variety performance tests are used to estimate potential yield differences between varieties.

Insects, disease, and weeds often prevent yields from reaching their full potential. Additional research is being done to account for the yield effects of other practices farmers employ. These include use of disease-resistant seed stock, application of chemical herbicides and pesticides, more timely and effective tillage, minimum-tillage systems, and improved harvesting systems.

Sampling Frames and Survey Research

Research and operational experience during the past decade have brought an evolution in area-frame construction. Area frames are now based on stratification of land according to its agricultural use. In recent frames, a limited use of crop or commodity-type stratification, such as tree fruit, has been used to improve estimation and reduce workload for specialized commodities. Furthermore, frames constructed after 1974 use an interpenetrating sample design to select units from the frame. Chapter 2 thoroughly discusses the operational aspects of area-frame construction.

Area-Frame Research

Work in area-frame research focuses on three subjects: improved construction materials, analysis of new area frames, and special area-frame designs. Interpenetrating sampling is the selection of a sample by drawing several independent subsamples (called replicates) from the frame. Drawing samples from different replicates each year makes it possible to limit respondent burden. Other advantages include the ease of making variance computations from the replicated samples and the use of a subset of the replicates for special sampling purposes.

Rapid changes in farming often outdate aerial photographs, making them ineffective for stratification and a problem for enumeration. Satellite imagery has been

used operationally since 1979 as a stratification supplement in areas where the available photography is old. Also, a recently initiated program involving high-altitude infrared photography shows promise as an aid to solving enumeration and frame construction problems. Information generated by local agencies and universities on land use, irrigation, and urban planning also aids frame construction. In the next few years, the use of satellite data is expected to become a general tool for improving area-frame construction and maintenance and not just a technique for problem areas.

As noted in Chapter 2, SRS usually constructs new area frames in 3 or 4 States each year. SRS researchers are assembling an area-frame data base. Once operational, it should provide much of the information needed to decide which States should have new frames constructed, to determine the most efficient type of stratification for the State, and refine the completed stratification.

After the first JES using the new frame, the data are processed through a recently developed set of computer programs called the Area Frame Analysis Package that provides graphic and statistical information used for a detailed analysis of the frame construction and the sources of variation. Often this analysis uncovers nonsampling errors, ways to improve allocations and design, or construction alternatives which could be useful in developing future frames.

The Sampling Frame Development Section is often asked to develop special area-frame designs. For example, the section worked cooperatively with NASA to construct area frames for Georgia, North Carolina, and portions of Argentina and Brazil. These frames were used for crop area estimation by remote sensing methods in the AgRISTARS program. Often the construction of these special designs improves the capabilities of the section. For example, an outgrowth of developing the NASA frames was the section's ability to use advanced computer technology to enhance the quality control of the frame construction process and to save on manual and automated processing costs. Other recent examples of frame development projects were the construction of a specialty frame for dry beans in Michigan, the use of the JES to collect socioeconomic data concerning pine reforestation, and the collection of rural household data for special economic surveys.

Nonsampling Errors

Estimates from surveys are subject to two types of errors—sampling errors and nonsampling errors. Sampling errors result from collecting data on a sample instead of the entire population and are controlled by modifying sample design and sample size. For probability surveys, the sampling error can be estimated and used to assess the precision of the survey. On the other hand, nonsampling errors refer to all the other errors which can affect the collection of data, including interviewer effects, wording of questions, editing, and refusals. Thus, nonsampling errors affect data from censuses as well as samples. Not only is it hard to discover all the nonsampling errors affecting the accuracy of a survey, it is also difficult to accurately measure them and find remedies.

Nonsampling errors can be found in a number of ways. A critical review of the details of the survey procedures can reveal many obvious errors. However, survey designers usually learn of the more elusive nonsampling errors through feedback received from enumerators and field statisticians, indepth reinterviews with respondents, and comparisons of sample survey data with censuses or administrative information.

After possible nonsampling errors are identified, research statisticians can then design experiments to measure the level of these nonsampling errors. These experiments commonly use either replicated sampling (where each replicate receives a different treatment) or "repeat unit" testing where each sample unit is subjected to each treatment. Difficulties encountered in designing experiments to measure nonsampling errors are obtaining a sample size large enough to detect the often subtle effects of nonsampling errors, disentangling how much bias is due to each type of error, and controlling nonsampling errors arising in the research experiments themselves.

Once research statisticians measure the size of a particular nonsampling error, investigation begins on possible remedies. Much of the information collected by SRS is from repetitive surveys and is used in the sense of "change over time." Therefore, a nonsampling error is not necessarily a problem if the relative size of the error is constant from one data collection period to another. Other nonsampling errors, however, may be large or erratic and can require changes in the survey procedure. The last stage of research is to develop alternative survey procedures, test these procedures in an operational setting, and compare all the advantages and disadvantages of these procedures to the current operational procedure.

Many sources of nonsampling errors are investigated by SRS. Some of the major types studied are described here.

Nonresponse

Nonresponse is a major nonsampling error which is continually being investigated by SRS. Research on nonresponse began when a general trend of increasing nonresponse rates on surveys during the seventies, particularly in the Midwest, called attention to the effects of nonresponse and the procedures used to adjust for nonresponse. In 1975, SRS began research on the effects of nonresponse procedures which might improve the accuracy and reliability of the operational procedures. Work first began with the hog and cattle multiple-frame surveys and explored the qualities of "hot deck" procedures, ratio procedures, regression procedures, and "nearest neighbor" procedures. Current and future research will investigate the effects of nonresponse on all SRS surveys and the effects of any new procedures to adjust for these biases.

Interviewer Effects

Another area of continuing interest to SRS is the effects of interviewers on the data. In previous research, comparisons of estimates between interviewing procedures like mail-personal delivery and personal interview reflect a "no interviewer" effect versus a "strong interviewer" effect. Testing showed that the data are affected by the involvement of an interviewer, but outside of the fact that personal interviews improve response rates, it is difficult statistically to determine whether this effect is good or bad.

Other more detailed investigations are underway to study the effects of telephone interviewers. One research study has indicated that there are different effects on the collected data among different telephone interviewers. Another study showed that male telephone interviewers had different effects from female interviewers—for example, the length of the interview was longer for male interviewers. However, much information is still needed on the interaction of interviewers and respondents.

Questionnaire Design

Before changes are made in the design, especially the wording, of an operational questionnaire, they are tested by SRS for nonsampling errors. The effects of questionnaire design can be so subtle that this testing must be done even if the change in the wording or ordering appears trivial. Many studies, especially in opinion polling, have shown the subtle effects of questionnaire design on the respondent's answers.

Research studies in SRS have shown that wording of questions can have large effects on quantitative variables, even on such supposedly definite terms as number of calves born on the farm and number of total acres in the farm. Other research studies have shown that the ordering of the questions can also have significant effects. For example, SRS surveys ask farmers to report their market hogs in four weight categories: "Under 60 pounds," "60-119 pounds," "120-179 pounds," and "180 pounds and over." A study showed that if the order of the weight categories is reversed, the number of hogs reported as "180 pounds and over" increases by over half, suggesting that farmers have a tendency to ignore what their hogs weigh and to report them in the first category given. It is difficult to realize that these types of tendencies occur until testing compares estimates from one questionnaire design against another.

Respondent Biases

SRS has always done research on respondent biases because these biases have an obvious link to the difficulties of questionnaire design. It is underlying respondent biases that commonly cause the effects of questionnaire design. Respondent biases even influence variables that could be considered very definite and specific. For example, on many SRS livestock surveys farmers are requested to report the number of livestock on the land they operate regardless of ownership. This question is simple and avoids the immense complications of ownership questions. However, several studies have shown that farmers still have a strong tendency to report by ownership even when the farmer understands the question and acknowledges the phrase "regardless of ownership."

Editing

Once survey data are collected, field statisticians review the answers on each questionnaire for consistency and completeness. They then edit any answers that appear illogical, but if there are major problems in the answers, they call the interviewer involved or recontact the respondent. Also, field staff code some of the data to indicate the type of farm, gross farm income, nonoverlap with another list frame, and so forth. Research has

shown that this editing has a large impact on estimation. The nonsampling errors introduced in this process are still relatively unexplored, although SRS plans to explore them in the future.

Mathematical Bias

This type of nonsampling error refers to the theoretical effects in the formula of an estimator. Both regression and ratio estimators have well-known mathematical biases, although the sizes of their biases decreases as the sample size increases. Thus, the biases are only important when working with small sample sizes or small subgroups of the sample. Newly developed estimators must be evaluated by SRS for mathematical biases not only in the direct estimates but also in the measures of precision. Two recent examples of research in this area are the bias involved with estimating the ratio of two random variables and the bias involved with some small area estimators.

Development of New Survey Methods

Development of new survey methodology is prompted by the changing structure of populations, new and increasing needs for data, new statistical theory, and innovative technology in computers and other survey tools. SRS continually researches new methods as an avenue for improving the quality of existing data series. Current and future research will focus on computer-assisted telephone interviewing, county estimation, and robust estimation.

County Estimation

There is an expanding need for estimates on small geographical units. In agriculture the demand is for crop and livestock estimates at a county level. While a periodic census can furnish such data, annual sample surveys are usually too small to furnish stable estimates on such a small domain of the population. Researchers are experimenting with estimators and survey designs which would yield reliable county estimates. Initial studies in a test State showed that county-level estimators which only rely on current survey information from a sample would be so unstable that time trends and relationship among counties would be unrecognizable. However, combining information from the current sample with models built on historical data furnished stable and fairly accurate estimates for variables related to acreages of major crops. Further research is planned to investigate county estimates of crop yields, county estimates of minor crops, the inclusion of weather data in the models, and models using data from the U.S. Census of Agriculture.

Computer-Assisted Telephone Interviewing

Computer-assisted telephone interviewing (CATI) refers to the use of computers for telephone interviewing and related forms of data collection, data entry, editing, and coding. During a telephone interview, the interviewer sits in front of a computer terminal screen and speaks with the respondent. The computer displays each question in turn on the screen. The interviewer types each answer onto the terminal keyboard. The computer performs any desired checks for consistency and, if needed, displays a question requesting clarification. The computer stores the information, selects the next appropriate question, and displays it on the screen.

In addition to these basic functions, advanced CATI systems can facilitate sample control, survey coding, and many additional survey operations as interviews are being conducted. Compared with traditional telephone data collection, CATI surveys have five potential advantages: improvements in data quality by the use of on-line checks and edits, accurate control of skips and branches in the questionnaire that eliminates additional call-backs, speed in conducting interviews and processing data, greater flexibility in questionnaire design, and construction of questions during the interview tailored to the respondent's characteristics. A CATI system also offers the opportunity for improvements in survey management procedures through the automation of interview and callback scheduling, improved capability to monitor and evaluate enumerators, and instantaneous summaries of the status of the survey.

Experimentation with CATI began in 1980 under a cooperative agreement with the University of California at Berkeley. This agreement provided access to a sophisticated CATI system and supported the continued development of that system. The initial experiences have been favorable and research is continuing on a broader scale.

Robust Estimation

Almost all agricultural surveys have a problem with outliers in the data sets, as noted in Chapter 2. This problem occurs in agricultural firms because of the extremely skewed distribution brought about by the many small farms and a smaller number of extremely large farms. Some control of the problem is accomplished through sample design, especially stratification. However, because farming operations can change radically in a short time, very large values always seem to appear in data sets, even for stratified samples. A technique known as robust estimation has received much attention in the statistical literature of the last decade. A research study has just begun to sift through this literature and experiment with methods to identify and adjust for outliers.

Glossary

These definitions explain SRS usage of certain terms in the text.

Area frame A sample frame comprising land segments which cover the entire land area in the survey and from which a sample can be selected. (See Segment.)

Benchmark data Data based on a complete or nearly complete enumeration which can be used to revise, if necessary, a previously established estimate. (Benchmark data are seldom available on a current basis.)

Biological yield The gross or total amount of crop produced by the plants expressed as a rate per unit; for example, bushels per acre and pounds per tree. (See Net harvested yield.)

Backup procedures, ADP The provisions made for the recovery of data files and program libraries and for restart or replacement of ADP equipment after a system failure or disaster.

Check data Information derived from marketings, inspections, acreages contracted or certified, assessments, ginnings, and other sources that has some direct relation to a commodity and can be used, with varying degrees of confidence, to supplement survey data in the preparation or revision of estimates.

Closed segment A method of associating area-frame survey data with a segment that includes only the agricultural activities that are within the segment boundaries.

Composite estimator An estimator derived from the combination of two or more separate indications for the same characteristic. Predetermined weights are used to combine the indications.

Confidentiality The specific status and degree of protection that must be provided for data about individuals or organizations.

Contingency plan, ADP A comprehensive plan, consisting of three phases, to deal with disastrous events. The emergency phase attempts to limit the damage, the backup phase provides for maintenance of critical mission capability after loss of a service, and the recovery phase is a plan for restoration of service.

Control data Data which are attached to sampling frame units to describe the operation. For example, all land and cropland acreages and numbers of cattle and hogs are control data for farm operations.

Count limb A randomly selected tree limb on which fruit or nut counts are made. Often referred to as the terminal branch or limb.

Count unit In field-crop objective yield surveys, a small randomly selected sample plot in which counts, measurements, and observations are made on plants. In tree objective yield surveys, a randomly selected cluster of trees, usually two to four, from which objective counts and measurements are made on the fruit or nuts. In area-frame construction, primary sampling units ranging in size from 2 to 10 segments.

Crop reporters Persons who voluntarily report information about their farms or localities for use in SRS forecasting and estimating programs.

Crop Reporting Board A group of SRS statisticians consisting of a permanent chairperson (the deputy administrator of SRS), a permanent secretary, and other members designated by the chairperson to review survey and check data, and establish State and national agricultural estimates.

Crop reporting district A contiguous group of counties having relatively similar agricultural characteristics. Most States are assigned nine districts.

Current/current ratio A survey indication of change from a previous survey period, obtained by dividing currently reported data by data reported for the same reporting units in the preceding survey. Also called "identical ratio."

Current/historical ratio A survey indication of change from the previous year, obtained by dividing the current year's data by the reporters' current estimates of similar data for the preceding year. Data for both years are reported on the same questionnaire.

Data base management system A software product that controls a data structure containing interrelated data stored to optimize accessibility, control redundancy, and permit multiple applications of the data.

Direct expansion An unbiased estimator obtained by multiplying the sample data by the reciprocal of the probability of selecting the sampling unit, or expansion factor. The summation of expanded data for all selected sampling units is the direct expansion estimate of the population.

Enumeration In a sample survey, collection and recording of statistical information for all selected sampling units.

Enumerative survey A survey that obtains statistical information for the selected sampling units by personal interviews with the respondents.

Enumerator A person employed specifically to obtain information on sampling units by personal or telephone interviews with the respondents. Also called "interviewer." Also, a person employed specifically to make counts, measurements, and observations in sample plots of field crops or on count limbs of tree crops for objective yield surveys.

Estimate An approximate measure of the actual quantity of an item, usually derived by calculation from sample data.

Estimator A rule, method, or formula for generating estimates from sample data.

Forecast A quantitative evaluation of probable final outturn, based on current conditions and the assumption that normal growth and harvesting conditions will prevail from the time of forecast through harvest.

Identical ratio Same as current/current ratio.

Indication A numerical value calculated from survey data used directly or interpreted through regression and time-series charts to establish estimates.

Intentions A quantitative estimate of probable future action to be taken based on current plans reported by respondents; for example, area to be seeded to corn or number of sows to be farrowed.

Landsat An earth resource monitoring satellite. Landsat carries instruments that measure energy being reflected, emitted, or absorbed by the earth's surface.

Limited forecast or estimate A program in which the number of forecasts or estimates made during the season is fewer for minor producing States than for major producing States. Minor producing States are defined as those that individually produce less than 1 percent, and in the aggregate less than 5 percent, of the U.S. commodity total.

List frame A sampling frame that consists of a list of individuals, businesses, or other entities from which a sample can be selected. For example, SRS frequently uses a list of the names and addresses of farm operators with control data.

Mail survey A survey using questionnaires that are mailed to intended respondents, who are asked to fill them out and return them by mail. In probability mail surveys, nonrespondents are interviewed by personal visit or by telephone to obtain the required data.

Multiple-frame survey A survey in which the sample is selected from two or more sampling frames (usually an area frame and a list frame).

Net harvested yield The portion of total crop production harvested and recovered, expressed as a quantity per unit of area, derived by deducting harvesting and other losses from the biological yield.

Nonoverlap domain In multiple-frame sampling, that portion of the area-frame population that is not in the list frame.

Nonprobability survey A survey in which the sampling procedures are not based on the probabilities of selection. The most common example is a mail survey that uses incomplete sampling frames.

Nonresponse Failure of a respondent to reply to a survey inquiry.

Objective yield survey A scientifically designed survey of small, randomly selected crop areas (sample plots) in which measurements, counts, and observations are made in order to forecast or estimate yield.

Open segment A method of associating area-frame survey data with a segment. All agricultural activities of farms whose headquarters are located inside the segment boundaries, even though some of the activity may be outside the segment boundaries.

Overlap domain In multiple-frame sampling, that portion of the area-frame population that is also included in the list frame.

Parity index An index of prices paid by farmers for commodities and services, including payments of interest, taxes, and wages, using 1910-14 as the base.

Parity price The price that gives a unit of a farm commodity the equivalent purchasing power it had in 1910-14.

Parity ratio Ratio of the index of prices received by farmers to the parity index, with both indexes using 1910-14 as the base.

Probability survey A survey in which every element in the population has a known, nonzero probability of being selected for the sample. Data must be obtained, insofar as possible, for all sampling units selected.

Projection A quantitative expectation of some future value, based on historical data relations and possible current circumstances, but not on current survey data, as is a forecast.

Ratio estimator Any estimator that uses a ratio as a multiplier of a known or estimated base. (In practice, the ratio is derived from survey data.)

Ratio relative A survey indication of change obtained by dividing a current-year survey ratio (such as the ratio of a specific crop acreage to total land) by the comparable survey ratio for the preceding year.

Ratio to base A ratio estimator whose divisor or "base" is known in advance and is part of the sampling frame.

Recommendation Preliminary value recommended by SSO for adoption as final values by SRS. Recommendations are subject to revision and reconciliation by the CRB before adoption as official estimates.

Record linkage The process of identifying by computer techniques any duplication of names on one or more lists.

Regression chart A graph that shows the historical relations between sample survey indications and the corresponding final estimates, and that is used to prepare a current forecast or estimate from survey indications.

Regression estimator An estimator that uses an approximately linear relationship between a primary and auxiliary variable to increase the precision beyond that of a direct expansion estimator, which uses only the primary variable. The auxiliary variable must be measurable for both the sample and the universe.

Remote sensing Detection of information from a distance. Usually the information is acquired from measurement instruments aboard aircraft or space vehicles, such as Landsat.

Sampling frame A collection of sampling units in a survey population, ideally having no duplication or omission of units, from which samples may be drawn.

Sampling unit One of the units into which a survey population is divided and that is subject to being selected as part of a sample.

Segment A piece of land, generally between 0.1 and 4 square miles in area, with boundaries identifiable on a map and on the ground, that is considered to be the sampling unit of interest in SRS area-frame sampling.

Speculative commodities Commodites designated by USDA regulations because they are traded on organized commodity exchanges. Forecasts and estimates for these commodities are prepared under special security precautions. (For 1983, these commodities were sweet oranges, corn, cotton, soybeans, and wheat.)

System security All the technological safeguards and managerial procedures established and applied to computer hardware, software, and data in order to ensure an acceptable level of protection for data, organization assets, and individual privacy.

Telecommunications Any transmission, emission, or reception of signs, signals, writing, images, sounds, or other information by wire, radio, visual, or other electromagnetic means.

Teleprocessing An integrated information transmission system that combines telecommunications, ADP systems, and operator terminals.

Time-series chart A graph that shows the change in one or more variables over a period of time.

Tract The area of land located within a segment that is under a single operation or management.

Weighted segment The method of associating survey data with a segment that apportions a farm's activities to the segment by the fraction of the farm's acreage that lies within the segment boundaries.

Appendix A

Chronology

1839 Congress appropriates $1,000 to Patent Office for "collection of agricultural statistics and distribution of seeds."

1841 Using 1840 Agricultural Census as a benchmark, Patent Office issues first crop report. Annual releases continue until 1848.

1855 President of Maryland Agricultural Society proposes that all State agricultural societies appoint men in each county to report on crops.

1858 Editor of *American Agriculturalist* asks subscribers for crop comments and publishes his appraisal. In 1862, he sends questionnaires to these reporters.

1862 U.S. Department of Agriculture established.

1863 Division of Statistics formed in USDA as predecessor of today's SRS.

First monthly crop report issued by USDA in July showing May-June conditions reported by 2,000 farmer-correspondents.

1866 Beginning of continuous series of reports on major crops, livestock, and agricultural prices.

1882 Part-time statisticians appointed to develop and maintain group of voluntary crop reporters and provide current information on agriculture.

1892 Now 15,000 farmer-reporters provide data for monthly surveys, and 125,000 furnish survey data for annual estimates.

1896 Opening of rural free delivery mail service paves way for speedier reports from farmers and new township correspondents.

1898 More statisticians assigned, plus traveling agents to observe farming conditions and provide coordination among States for estimates.

1903 In addition to crop reporters, 61,000 ginners, 24,000 millers and elevator operators, and 22,000 agents of railroads and transportation companies report on agriculture.

1905 Crop Reporting Board, a group of highly qualified agricultural statisticians from Washington and field offices, established to review information and set national and State estimates.

1908 Monthly reports begin on prices farmers receive for their products.

1909 Congress specifies which crops will be covered in crop report, stipulates issuance times, and requires Secretary of Agriculture to sign report. Statisticians, staff, and other workers prohibited by law from making premature disclosure of crop estimates, issuing false reports, or speculating on commodity market.

Beginning of reports on wages paid to hired farm labor.

1910 Annual report released on prices paid by farmers for 74 commodities. First monthly index of prices received by farmers covers 10 items.

Shift from reporting monthly crop conditions to forecasting actual production during the growing season for all major crops except cotton.

1914 Part-time statisticians upgraded to full-time jobs under U.S. Civil Service.

Commercial vegetable and cold storage reports begin.

1915 Cotton production forecasts now available during growing season.

1917 Wisconsin signs first formal agreement establishing cooperative Federal-State crop-estimating program. (Agreements in effect with 48 States by 1967.)

Manufactured dairy products surveys initiated.

1919 South Carolina statistician does first fieldwork on objective measurements of crop acreages (now a significant element in SRS crop estimating).

Annual poultry survey starts.

1922 Rural mail carriers distribute first pig crop survey questionnaires.

1923 Annual report showing farmers' spring planting intentions issued in March.

Crop meter, a device attached to an automobile odometer, invented by Mississippi statistician to measure crop frontages as acreage guide.

Livestock reporting work reorganized and expanded.

1924 Rural mail carrier system used to distribute questionnaires on crop acreages.

1925 First 5-year census of agriculture taken; previously taken every 10 years.

1926 Quarterly estimates of farm stocks of grain start.

1927 Statisticians required to take special training to improve skills.

1928 Objective measurements for forecasting yield start with cotton; corn and wheat later, but are discontinued at the start of World War II.

1933 Statistical agency provides assistance in reviewing crop acreages and hog numbers for allotment program under Agricultural Adjustment Act.

1936 Volume of USDA farm data prompts separate annual publication titled *Agricultural Statistics.*

1941 Chicago dairy office established for weekly reports on butter, cheese, and other dairy products.

1943 Quarterly estimates of grain stocks off farms in mills and elevators begin.

1944 Master area sample of agriculture drawn at Iowa State University with SRS help to aid in developing first probability acreage surveys.

1945 Forerunner of today's enumerative surveys launched with interviews of 20,000 farmers in 158 counties and 42 States concerning farm labor.

1950 SRS establishes a new program to provide on-the-job training to junior and senior agricultural college students.

1951 Technical assistance to foreign countries in the collection, tabulation, analysis, and use of agricultural statistics greatly expands. This work has continued to grow as a dynamic activity.

1952 SRS estimating program strengthened with funds for research on methods for developing and improving statistical techniques.

1954 June enumerative survey of crop acreages opens on research basis in 10 States, 100 counties, and 703 segments.

Experimental objective yield measurements of cotton made in 200 sample units of 76 counties in 10 States. Similar work starts on corn the same year; wheat in 1955; soybeans in 1956.

1956 First comprehensive farm production expenditures survey conducted.

1961 Objective yield surveys for cotton and corn become operational, providing the CRB with additional indications of yield per acre.

SRS and Iowa State and North Carolina State Universities set up program to offer specialized training for SRS statisticians.

1962 SRS begins use of computers—Data Processing Branch created.

Wheat objective yield survey becomes operational.

1965 CRB for the first time establishes national and regional acreage estimates before review of State estimates.

June enumerative survey operational in 48 States, providing first probability survey of crop acreages at the national level.

1966 Continuous crop and livestock estimating program enters second century.

1967 Washington Data Processing Center, serving computer needs for all USDA agencies and many outside Department, opens under SRS.

Soybean objective yield survey becomes operational.

First quarterly farm labor survey conducted as a pilot program.

1969 Probability grain stocks surveys conducted for first time.

1970 Multiple-frame survey methods added to cattle and hog estimating procedures.

1971 Funds appropriated for annual farm production expenditures surveys. No similiar surveys were conducted between 1956 and 1971.

1972 Chicago Dairy Office closed and work transferred to Wisconsin SSO and Livestock, Dairy, and Poultry Branch, Estimates Division, Washington, D.C. Washington Data Processing Center transferred to Office of Automated Data Systems, USDA, as part of a consolidation of ADP facilities.

SRS funded, as principal investigator, to develop new ways to use satellite data to improve estimates of crop acreage.

1973 Selected SSO's and the central Washington Office connected to a telecommunications network. Network presently connected to all SSO's, except Alaska.

1974 SRS participates with NASA and NOAA in the Large Area Crop Inventory Experiment, a major interdepartmental effort to demonstrate the potential of satellite data and weather data for use in worldwide crop production estimation and forecasting for wheat.

Quarterly farm labor survey becomes operational.

1976 The automated crop reporting system, using data base management methodology, becomes operational.

1977 The root mean square error, a statistical measure based on past performance, included in reports for selected crops to assist users in evaluating the reliability of production forecasts.

Probability surveys implemented for obtaining prices received by farmers for grain based on actual transactions and quantities purchased.

1978 AgRISTARS, under the leadership of SRS, developed as an interagency research program to evaluate the potential of aerospace remote sensing data in meeting USDA information needs.

Research implemented to evaluate plant process models for estimating and forecasting yields.

1979 List frame, a standardized method for building and maintaining a list of names for sampling, becomes operational.

Probability surveys implemented for obtaining prices received by farmers for livestock based on actual transactions and quantities purchased.

1980 AgRISTARS research program implemented. Research and development continues with SRS assigned a broader research role in addressing worldwide applications.

1981 An outside review team of statisticians independent of the Department completed a broad review of SRS procedures used in sampling, data collection and processing, estimation, and publication in terms of current statistical theory and state-of-the-art survey methodology.

A cooperative agreement between SRS and University of California at Berkeley implemented to investigate computer-assisted telephone interviews.

1982 SRS estimating program modified because of budget constraints. Available resources redirected toward maintaining timely and available data series judged to be the most important in monitoring changes in the agricultural sector.

Free distribution of releases through the CRB and SSO's discontinued. CRB publications now available by subscription.

SRS training programs modified to offer dual qualifications for statisticians and specialized advanced training for ADP statisticians.

1983 Clearance Office transferred to the Department's Office of Information Resource Management.

SRS developed its second comprehensive, long-range framework plan for improved statistical standards, integrated survey programs, and data management systems.

Appendix B

Laws Governing Crop Reports

Title 7, Section 2202

The Department of Agriculture, shall be an Executive Department, under the supervision and control of a Secretary of Agriculture, who shall be appointed by the President, by and with the advice and consent of the Senate; . . .

Title 7, Section 2204

The Secretary of Agriculture shall procure and preserve all information concerning agriculture, rural development, aquaculture, and human nutrition which he can obtain by means of books and correspondence, and by practical and scientific experiments, accurate records of which experiments shall be kept in his office, by the collection of statistics, and by any other appropriate means within his power; he shall collect new and valuable seeds and plants; shall test, by cultivation, the value of such of them as may require such tests; shall propagate such as may be worthy of propagation; and shall distribute them among agriculturists; . . .

Title 7, Section 411a

Monthly Crop Report; Contents; Issuance; Approval by Secretary of Agriculture. The monthly crop report, which shall be gathered as far as practicable from practical farmers, shall be printed and distributed on or before the twelfth day of each month, and shall embrace statements of the conditions of crops by States, in the United States, with such explanations, comparisons, and information, as may be useful for illustrating the above matter, and it shall be submitted to and officially approved by the Secretary of Agriculture before being issued or published.

Title 18, Section 1902

Disclosure of Crop Information and Speculation Thereon. Whoever, being an officer, employee or person acting for or on behalf of the United States or any department or agency thereof, and having by virtue of his office, employment or position, become possessed of information which might influence or affect the market value of any product of the soil grown within the United States, which information is by law or by the rules of such department or agency required to be withheld from publication until a fixed time, willfully imparts, directly or indirectly, such information, or any part thereof, to any person not entitled under the law or the rules of the department or agency to receive the same; or, before such information is made public through regular official channels, directly or indirectly speculates in any such product by buying or selling the same in any quantity, shall be fined not more than $10,000 or imprisoned not more than ten years, or both. No person shall be deemed guilty of a violation of any such rules, unless prior to such alleged violation he shall have had actual knowledge thereof.

Title 18, Section 1905

Disclosure of Confidential Information Generally. Whoever, being an officer or employee of the United States or of any department or agency thereof, or agent of the Department of Justice as defined in the Antitrust Civil Process Act (15 U.S.C. 1311-1314), publishes, divulges, discloses, or makes known in any manner or to any extent not authorized by law any information coming to him in the course of his employment or official duties or by reason of any examination or investigation made by, or return, report or record made to or filed with, such department or agency or officer or employee thereof, which information concerns or relates to the trade secrets, processes, operations, style of work, or apparatus, or to the identity, confidential statistical data, amount or source of any income, profits, losses, or expenditures of any person, firm, partnership, corporation, or association; or permits any income return or copy thereof or any book containing any abstract or particulars thereof to be seen or examined by any person except as provided by law; shall be fined not more than $1,000, or imprisoned not more than one year, or both; and shall be removed from office or employment.

Title 18, Section 2072

False Crop Reports. Whoever, being an officer or employee of the United States or any of its agencies, whose duties require the compilation or report of statistics or information relating to the products of the soil, knowingly compiles for issuance, or issues, any false statistics or information as a report of the United States or any of its agencies, shall be fined not more than $5,000 or imprisoned not more than five years, or both.

Title 7, Section 471

Statistics and Estimates of Grades and Staple Length of Cotton; Collection and Publication. The Secretary of Agriculture is authorized and directed to collect and publish annually, on dates to be announced by him, statistics or estimates concerning the grades and staple length of stocks of cotton, known as the carryover, on hand the 1st day of August of each year in warehouses and other establishments of every character in the continental United States; and following such publication each year, to publish, at intervals in his discretion, his estimate of the grades and staple length of cotton of the then current crop: Provided, That not less than three such estimates shall be published with respect to each crop. In any such statistics or estimates published, the cotton which on the date for which such statistics are published may be recognized as tenderable on contracts of sale of cotton for future delivery under the United States Cotton Futures Act of August 11, 1916, as amended, shall be stated separately from that which may be untenderable under said Act as amended.

Title 7, Section 475

Cotton Crop Reports. The Secretary of Agriculture shall cause to be issued as of the first of each month during the cotton growing and harvesting season from August to January inclusive, reports describing the condition and progress of the crop and stating the probable number of bales which will be ginned, these reports to be issued simultaneously with the cotton ginning reports of the Bureau of the Census relating to the same dates, the two reports to be issued from the same place at 3 o'clock postmeridian on or before the 12th day of the month to which the respective reports relate. No such report shall be approved and released by the Secretary of Agriculture until it shall have been passed upon by a cotton crop reporting board consisting of five members or more to be designated by him. Not less than three members of the board shall be supervisory field statisticians of the Department of Agriculture who are located in different sections of the cotton-growing States, are experienced in estimating cotton production and have first hand knowledge of the condition of the cotton crop based upon recent field observations. A majority of the members of the board shall be familiar with the methods and practices of producing cotton.

Title 7, Section 476

Acreage Reports. The Secretary of Agriculture shall cause to be issued a report on or before the 12th day of July of each year showing by States and in toto the estimated acreage of cotton planted, to be followed on or before the 12th day of August with an estimate of the acreage for harvest and on or before the 12th day of December with an estimate of the harvested acreage.

Title 12, Section 1141j(d)

Governmental Publication; Predictions as to Cotton Prices Prohibited. The inclusion in any governmental report, bulletin, or other such publication hereafter issued or published of any prediction with respect to cotton prices is prohibited. Any officer or employee of the United States who authorizes or is responsible for the inclusion in any such report, bulletin, or other publication of any such prediction, or who knowingly causes the issuance or publication of any such report, bulletin, or other publication containing any such prediction, shall, upon conviction thereof, be fined not less than $500 or more than $5,000, or imprisoned for not more than five years, or both: Provided, That this subdivision shall not apply to the Governor of the Farm Credit Administration when engaged in the performance of his duties herein provided.

Title 13, Section 42

Contents of Reports; Number of Bales of Linter; Distribution; Publication by Department of Agriculture.

(a) The statistics of the quantity of cotton ginned shall show the quantity ginned from each crop prior to August 1, September 1, September 15, October 1, October 15, November 1, November 15, December 1, December 15, January 1, January 15, February 1, and March 1; but the Secretary may limit the canvasses of August 1 and September 1 to those sections of the cotton growing States in which cotton has been ginned.

(b) The quantity of cotton consumed in manufacturing establishments, the quantity of baled cotton on hand, the number of active consuming cotton spindles, the number of active spindle-hours, and the statistics of cotton imported and exported shall relate to each month, and shall be published as soon as possible after the close of the month.

(c) In collecting and publishing statistics of cotton on hand in warehouses and other storage establishments, and of cotton known as the "carry-over" in the United States, the Secretary shall ascertain and publish as a separate item in the report of cotton statistics the number of bales of linters as distinguished from the number of bales of cotton.

(d) The Secretary shall furnish to the Department of Agriculture, immediately prior to the publication of each report of that Department regarding the cotton crop, the latest available statistics hereinbefore mentioned, and the Department of Agriculture shall publish the same in connection with each of its reports concerning cotton.

Title 13, Section 43

Records and Reports of Cotton Ginners. Every cotton ginner shall keep a record of the county or parish in which each bale of cotton ginned by him is grown and report at the completion of the ginning season, but not later than the March canvass, of each year a segregation of the total number of bales ginned by counties or parishes in which grown.

Title 13, Section 44

Foreign Cotton Statistics. In addition to the information regarding cotton in the United States provided for in this subchapter, the Secretary shall compile, by correspondence or the use of published reports and documents, any available information concerning the production, consumption, and stocks of cotton in foreign countries, and the number of cotton-consuming spindles in such countries. Each report published by the Department of Commerce or agency or bureau thereof regarding cotton shall contain an abstract of the latest available information obtained under the provisions of this section, and the Secretary shall furnish the same to the Department of Agriculture for publication in connection with the reports of that department concerning cotton in the same manner as in the case of statistics relating to the United States.

Title 13, Section 45

Simultaneous Publication of Cotton Reports. The reports of cotton ginned to the dates as of which the Department of Agriculture is also required to issue cotton crop reports shall be issued simultaneously with the cotton crop reports of that department, the two reports to be issued from the same place at 3 o'clock postmeridian on or before the 12th day of the month to which the respective reports relate.

Title 7, Section 411b

Estimates of Apple Production. Estimates of apple production shall be confined to the commercial crop.

Title 7, Section 951

Collection and Publication; Facts Required; Submission of Report. The Secretary of Agriculture is authorized and directed to collect and publish statistics of raw peanuts, shelled, unshelled, and crushed, and peanut oil, in the United States, received, processed, shipped, and owned by or in the possession of warehousemen, brokers, cleaners, shellers, dealers, growers' cooperative associations, crushers, salters, manufacturers of peanut products, and owners other than the original producers of peanuts: Provided, That the Secretary may, in his discretion, omit for any period of time to collect such statistics from any or all salters of peanuts or manufacturers of peanut products who used, during the calendar year preceding that for which statistics are being collected, less than thirty thousand pounds of shelled and unshelled peanuts. Such statistics shall show the quality of peanuts in such details as to kinds—Virginias, Runners, Spanish, and imported varieties—as the Secretary shall deem necessary for the purposes of this Act.All reports shall be submitted monthly in each year, except as otherwise prescribed by the Secretary.

Title 7, Section 501

Collection and Publication; Facts Required; Deteriorated Tobacco. The Secretary of Agriculture is authorized and directed to collect and publish statistics of the quantity of leaf tobacco in all forms in the United States and Puerto Rico, owned by or in the possession of dealers, manufacturers, quasi-manufacturers, growers' cooperative associations, warehousemen, brokers, holders, or owners, other than the original growers of tobacco. The statistics shall show the quantity of tobacco in such detail as to types, groups of grades, and such other subdivisions as to quality, color, and/or grade for particular types, as the Secretary of Agriculture shall deem to be practical and necessary for the purposes of this Act [7 U.S.C.§§ 501 et seq.], shall be summarized as of January 1, April 1, July 1, and October 1 of each year, and an annual report on tobacco statistics shall be issued: Provided, That the Secretary of Agriculture shall not be required to collect statistics of leaf tobacco from any manufacturer of tobacco who, in the first three quarters of the preceding calendar year, according to the returns of the Commissioner of Internal Revenue or the record of the Treasurer of Puerto Rico, manufactured less than thirty-five thousand pounds of tobacco, or from any manufacturer of cigars who, during the first three quarters of the preceding calendar year, manufactured less than one hundred and eighty-five thousand cigars, or from any manufacturer

of cigarettes who, during the first three quarters of the preceding year, manufactured less than seven hundred and fifty thousand cigarettes: And provided further, That the Secretary of Agriculture may omit the collection of statistics from any dealer, manufacturer, growers' cooperative association, warehouseman, broker, holder, or owner who does not own and/or have in stock, in the aggregate, fifty thousand pounds or more of leaf tobacco on the date as of which the reports are made. For the purposes of this Act [7 U.S.C.§§ 501 et seq.], any tobacco which has deteriorated on account of age or other causes to the extent that it is not merchantable or is unsuitable for use in manufacturing tobacco products shall be classified with other nondescript tobacco and reported in the "N" group of the type to which it belongs.

Appendix C

USDA Regulations Governing Crop Reports

The official regulations of the Department of Agriculture concerning the preparation of agricultural data estimates by SRS follow:

Departmental Regulation 1042-42

1. Purpose

This regulation describes the functions and authorities of the Crop Reporting Board, Statistical Reporting Service, and its responsibilities to prepare and issue the official State and national estimates and reports of the Department relating to crop production, livestock and livestock products, dairy and dairy products, poultry and poultry products, stocks of agricultural commodities, local market prices, value of farm products and such other subjects as the Administrator of the Statistical Reporting Service may direct. Among these reports will be a monthly crop report to be issued on or before the 12th of each month pursuant to 7 U.S.C., 411a.

2. Cancellation

This regulation supersedes Section 1, of Chapter 6 in Title I of the Administrative Regulations.

3. Policy

The Crop Reporting Board will prepare and issue the prescribed estimates and reports in a timely manner and protect against unauthorized access to sensitive information using diligence and adequate resources.

4. Abbreviations

CRB—Crop Reporting Board
SRS—Statistical Reporting Service

5. Definitions

a. *Speculative Data.* Data used by the CRB in the preparation of the monthly *Crop Production*, the *Grain Stocks* reports, or other CRB reports for an agricultural commodity or product listed below in a state listed below. This would include any information which would allow any person to anticipate the CRB reports pertaining to the U.S. yield, probable production or farm stocks of such designated commodities in the United States, or the production or farm stocks of such designated commodities in the United States, or the ginning of cotton in the United States.

The following crops and States are covered by this definition:

(1) Corn in Illinois, Indiana, Iowa, Minnesota, Nebraska, Ohio, and Wisconsin.
(2) Winter wheat in Illinois, Indiana, Kansas, Missouri, Nebraska, Ohio, Oklahoma, and Texas.
(3) Spring wheat in Minnesota, Montana, North Dakota, and South Dakota.
(4) Cotton in Arizona, Arkansas, California, Louisiana, Mississippi, and Texas.
(5) Soybeans in Arkansas, Illinois, Indiana, Iowa, Minnesota, Mississippi, Missouri, and Ohio.
(6) Sweet oranges in California and Florida.

b. *Non-speculative Data.* Data used in CRB reports other than that described in "a" above.

c. *Reports.* CRB reports of agricultural estimates data. These reports are authorized either by law, regulation, or the Administrator of SRS.

d. *Estimates.* Official State and national estimates relating to crops, livestock, dairy, poultry, prices, farm labor, and miscellaneous agricultural commodities included in CRB reports.

e. *CRB Rooms.* Locked rooms occupied by the CRB, statisticians, clerks, and other employees who assist the CRB while preparing a report.

f. *"Special A" Envelopes.* Envelopes used to transmit speculative data, before they are pub-

lished, into a special locked mailbox in the USDA Departmental Mail Unit.

6. Responsibilities

a. Chairperson of the CRB (who is Deputy Administrator of SRS or in the absence of same, the designee of the Administrator of SRS) will:
   (1) Select the members of the CRB for each CRB report;
   (2) Issue the instructions for collecting and summarizing data for reports specified in Section 11a;
   (3) Approve the techniques and procedures to be followed by SRS in analyzing the pertinent data and in preparing the official estimates;
   (4) Carry the "Special A" envelopes from the Departmental Mail Unit to the CRB Board Room;
   (5) Approve each report;
   (6) Officially release each report or give notice of a delay in release of the report;
   (7) Call for and preside over all meetings of the CRB;
   (8) Obtain certification of acknowledgment from each employee of SRS, or other persons who have access to survey information or estimates prior to publication, that they have read this regulation and will be governed by it.

b. Secretary of the CRB (a professional member of SRS at Headquarters designated by the Administrator of SRS) will:
   (1) Assist the Chairperson in preparing instructions and forms for collecting and compiling statistical data for use by the CRB;
   (2) Arrange for communicating instructions, records, and reports to and from SRS State Statistical Offices;
   (3) Maintain records of the information assembled, the CRB estimates and the signed copies of the CRB reports;
   (4) Assemble and collate information for use by the CRB;
   (5) Issue notices of CRB meetings;
   (6) Arrange for the preparation, signing, and release of CRB reports.

c. U.S. Government employees will: Protect data from unauthorized disclosure.

7. Organization of the CRB

a. For reports to be signed by the Secretary of Agriculture (see Section 11a), the Chairperson will select a minimum of five additional members from SRS, of which at least two will be from the SRS State Statistical Offices.

   Exception: *The CRB for cotton reports will consist of at least three members from SRS State Statistical Offices in cotton growing States.*

b. The Chairperson will select CRB members for other reports from SRS in a manner and in such numbers as deemed necessary by the Chairperson.

8. Information Collection

SRS Headquarters and State Statistical Offices will gather information for official estimates from farmers and ranchers (7 U.S.C., 411a); from peanut processors (7 U.S.C., 951 et seq.); from processors, dealers, cooperating State and local officials, agencies in the Department; and from other sources. The information will be collected by mailed questionnaire, sample enumeration, interviews or by other appropriate means (7 U.S.C., 411a, 951).

9. Information Not To Be Released and Statutory Provisions

a. *Speculative Data.* Information as defined in Section 5a, and the CRB reports and the contents thereof containing such information, will be withheld from unauthorized disclosure and publication until the day and hour of public issuance scheduled by the Secretary of Agriculture.

b. *Non-speculative Data.* Information as defined in Section 5b, and the CRB reports and the contents thereof containing such information, will be withheld from unauthorized disclosure and publication until the day and hour scheduled by the Chairperson of the CRB. The Chairperson may notify officers in charge of SRS State Statistical Offices, in advance of publication, of any changes made by the CRB from recommendations submitted by such offices.

c. Statutory provisions relating to unauthorized disclosure of crop information and issuance of false statistics.

(1) "Whoever, being an officer, employee or person acting for or on behalf of the United States or any department or agency thereof, and having by virtue of his office, employment or position, become possessed of information which might influence or affect the market value of any product of the soil grown within the United States, which information is by law or by the rules of such department or agency required to be withheld from publication until a fixed time, willfully imparts, directly or indirectly, such information, or any part thereof, to any person not entitled under the law or the rules of the department or agency to receive the same; or, before such information is made public through regular official channels, directly or indirectly speculates in any such product by buying or selling the same in any quantity, shall be fined not more than $10,000 or imprisoned not more than 10 years, or both. No person shall be deemed guilty of a violation of any such rules, unless prior to such alleged violation he shall have had actual knowledge thereof." (June 25, 1948, Chap. 645, Sec. 1, 62 Stat. 790, 18 U.S.C., 1902.)

(2) "Whoever, being an officer or employee of the United States or any of its agencies, whose duties require the compilation or report of statistics or information relating to the products of the soil, knowingly compiles for issuance, or issues, any false statistics or information as a report of the United States or any of its agencies, shall be fined not more than $5,000 or imprisoned not more than 5 years, or both." (June 25, 1948, Chap. 645, Sec. 1, 62 Stat. 795, 18 U.S.C., 2072.)

10. Transmission and Handling of Speculative Data

a. *Transmission to Washington, D.C.* Summaries of speculative data collected in the State Statistical Offices, together with recommendations of the officer in charge of each such office, will be transmitted by mail or electronically to Washington, D.C. by:

(1) Mail. When transmitted by mail, the summaries and recommendations will be forwarded in a sealed envelope marked "Special A" addressed to the Secretary of Agriculture.

(2) Electronic Transmission. When transmitted electronically, the summaries and recommendations will be forwarded in encoded form to the Secretary of the CRB.

b. *Departmental Handling Procedures.*

(1) Placing reports in locked mailbox.

(a) All "Special A" envelopes containing speculative data, when received by the Departmental Mail Unit from the U.S. Postal Service, will immediately be logged in by the Mail Unit without breaking the mail seals thereof, and placed in the locked mailbox provided for that purpose.

(b) All electronic transmissions containing encoded speculative data, when received by the Secretary of the CRB or designated representative, will immediately be placed in a "Special A" envelope without being decoded. The envelope will be sealed and delivered directly to the Departmental Mail Unit where the envelope will be logged in and placed in the locked mailbox provided for that purpose.

(2) Transferring "Special A" envelopes from locked mailbox to CRB rooms. Immediately preceding the convening of the CRB on the day a report is to be published, the locked mailbox in the Departmental Mail Unit containing the "Special A" envelopes will be opened and the envelopes removed in the presence of a designated representative of the Secretary of Agriculture, the Chairperson and the Secretary of the CRB, and a special guard provided by the General Services Administration. The Chairperson and the Secretary of the CRB accompanied by the guard, shall then carry the "Special A" envelopes directly to the CRB rooms.

c. *Safeguarding Information in the CRB Rooms.* Prior to the arrival of the Chairperson, Secretary of the CRB, and guard with the sealed "Special A" envelopes, the Secretary of the CRB will have all windows in the CRB rooms sealed to prevent communication between per-

sons within the CRB rooms and persons outside. Also, prior to the arrival, all telephones and other means of communication from the CRB rooms will be disconnected. Immediately after the entrance into the CRB rooms by the Chairperson and Secretary of the CRB with the sealed "Special A" envelopes, the guard will lock all doors leading from the CRB rooms, and remain on watch outside the CRB rooms until the report is released. While on watch, the guard shall not permit any communication between persons within the CRB rooms and persons outside except as provided below. The guard shall unlock the door only to permit:

(1) The entrance of the Secretary or Acting Secretary of Agriculture, authorized employees of SRS, and other persons who have written permission from the Chairperson;
(2) The delivery of written communications and supplies for use of the CRB to the CRB rooms;
(3) Notification to the guard by the Chairperson of a delay in completion of a CRB report (see Section 12c) or by the Chairperson or the Secretary of the CRB to convey emergency instructions essential to completion of a report; and
(4) The departure of:
    (a) The Chairperson, and such other persons as may be designated at the time by the Chairperson, for the purpose of proceeding to the Release Room immediately prior to the release of the report;
    (b) Any person in the case of extreme emergency, in which event a guard will accompany and remain with such person outside the CRB rooms until the release of the report; or
    (c) All persons in case of fire or other serious emergency.

11. Reports and Schedule of Reports

a. *Reports to be Approved by the Secretary of Agriculture.* The following CRB reports will be signed by the Chairperson, Secretary, and members of the CRB, and shall be approved by the Secretary of Agriculture before being issued or published:
    (1) *Crop Production* reports—monthly
    (2) *Crop Production* report—*Annual Summary*
    (3) *Grain Stocks* reports containing estimates on corn, wheat, or soybeans
    (4) *Small Grains*
        (a) *Annual Summary*
        (b) *Winter Wheat and Rye Seedings as of December 1*
    (5) *Prospective Plantings* reports
    (6) *Acreage* report—June
    (7) *Cattle* inventory reports
    (8) *Hogs and Pigs* inventory reports

b. *Other CRB Reports.* Other reports as designated by the Chairperson will be prepared and issued as CRB reports. Such reports shall be approved by the Chairperson or designee before being issued.

c. *Annual Release Schedules.* On or before the first day of December of each year there will be prepared a schedule for the ensuing year setting forth dates and hours of release of all regular statistical reports in "a" above. The schedule will be effective when approved by the Secretary of Agriculture and may be amended at any time with the Secretary's approval. Subsequently, there will be a listing of the reports referred to in "b" above, together with dates of publication or issuance.

12. Release of Reports

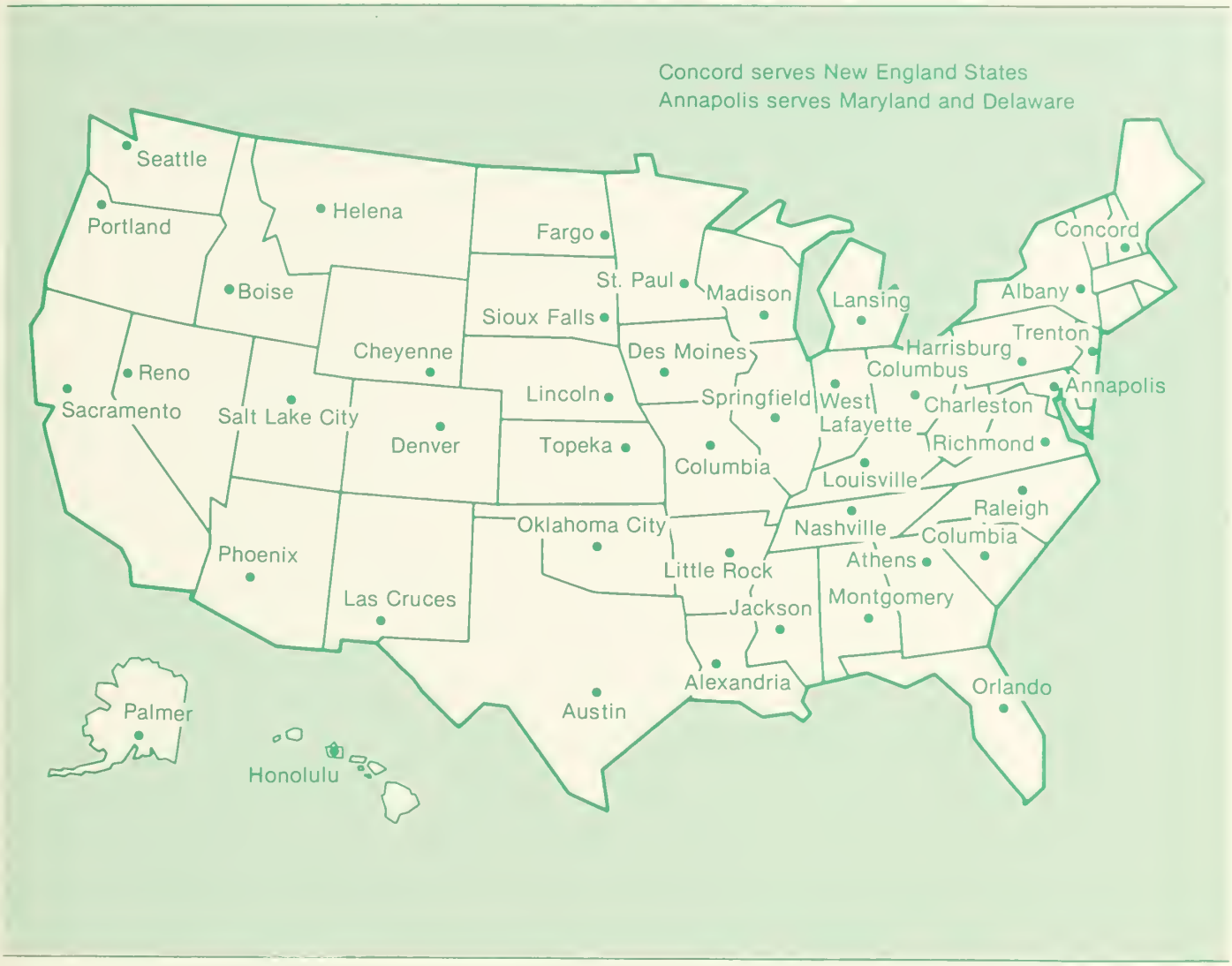
a. *Release Room.* The Chairperson of the CRB will designate a suitable space as the Release Room. The Release Room is for all press personnel desiring to transmit the report upon its official release.

b. *Release Procedure.* The Chairperson and the Secretary of the CRB, accompanied by such persons as may be designated at the time by the Chairperson, will take copies of the approved report from the CRB rooms to the Release Room before the time specified for the publication and release of the report. The limits of this area will be not less than 6 feet from the communication facilities. The Chairperson will then place copies of the report, face down, beside each instrument. At the exact time provided for the official issuance of each report, the Chairperson will state that the report is released to the public and permit access to the copies of the report. The Secretary of

the CRB will then notify the guard at the door of the CRB rooms that the report has been released. The guard will then unlock the doors of the CRB rooms.

c. *Delay in Releasing Reports.* If the report should not be completed and approved for issuance at the designated time, the Chairperson, not less than 10 minutes before the time designated for the release of the report, will notify the guard of the time when the report will be ready for release. The guard will immediately notify the representative designated by the Chairperson, who, in turn, shall notify the Secretary of Agriculture and all persons who are present in the Release Room to receive the report.

13. Employee Certification of Knowledge of Regulation

The SRS Deputy Administrator or authorized representative will obtain from each SRS employee or other persons having access to crop report data, in advance of publication, a certification that the person has read this regulation and will be governed by it.

State Statistical Offices of the Statistical Reporting Service